E 3510-22-P

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

[RTID 0648-XB163]

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to the Palmer Station Pier Replacement Project, Antarctica

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice; proposed incidental harassment authorization; request for comments on proposed authorization and possible renewal.

SUMMARY: NMFS has received a request from the National Science Foundation (NSF) for authorization to take marine mammals incidental to the Palmer Station Pier Replacement Project in Anvers Island, Antarctica. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting comments on its proposal to issue an incidental harassment authorization (IHA) to incidentally take marine mammals during the specified activities. NMFS is also requesting comments on a possible one-time, one-year renewal that could be issued under certain circumstances and if all requirements are met, as described in **Request for Public Comments** at the end of this notice. NMFS will consider public comments prior to making any final decision on the issuance of the requested MMPA authorizations and agency responses will be summarized in the final notice of our decision.

DATES: Comments and information must be received no later than **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**.

ADDRESSES: Comments should be addressed to Jolie Harrison, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service. Written comments should be submitted via email to *ITP.Pauline@noaa.gov*.

Instructions: NMFS is not responsible for comments sent by any other method, to any other address or individual, or received after the end of the comment period. Comments, including all attachments, must not exceed a 25-megabyte file size. All comments received are a part of the public record and will generally be posted online at *www.fisheries.noaa.gov/permit/incidental-take-authorizations-under-marine-mammal-protection-act* without change. All personal identifying information (*e.g.*, name, address) voluntarily submitted by the commenter may be publicly accessible. Do not submit confidential business information or otherwise sensitive or protected information.

FOR FURTHER INFORMATION CONTACT: Robert Pauline, Office of Protected Resources, NMFS, (301) 427-8401. Electronic copies of the application and supporting documents, as well as a list of the references cited in this document, may be obtained online at: *https://www.fisheries.noaa.gov/permit/incidental-take-authorizations-under-marine-mammal-protection-act*. In case of problems accessing these documents, please call the contact listed above.

SUPPLEMENTARY INFORMATION:

Background

The MMPA prohibits the "take" of marine mammals, with certain exceptions. sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq*.) direct the Secretary of Commerce (as delegated to NMFS) to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and either regulations are issued or, if the taking is limited to harassment, a notice of a proposed incidental take authorization may be provided to the public for review.

Authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s) and will not have an unmitigable adverse impact on the availability of the species or stock(s) for taking for subsistence uses (where relevant). Further, NMFS must prescribe the permissible methods of taking and other "means of effecting the least practicable adverse impact" on the affected species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of the species or stocks for taking for certain subsistence uses (referred to in shorthand as "mitigation"); and requirements pertaining to the mitigation, monitoring and reporting of the takings are set forth.

The definitions of all applicable MMPA statutory terms cited above are included in the relevant sections below.

National Environmental Policy Act

To comply with the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. 4321 *et seq*.) and NOAA Administrative Order (NAO) 216-6A, NMFS must review our proposed action (*i.e.*, the issuance of an IHA) with respect to potential impacts on the human environment.

Accordingly, NMFS plans to adopt NSF's Initial Environmental Evaluation (IEE), which is generally the equivalent of an environmental assessment (EA) under the Antarctic Conservation Act (16 U.S.C. 2401 *et seq.*), provided our independent evaluation of the document finds that it includes adequate information analyzing the effects on the human environment of issuing the IHA.

We will review all comments submitted in response to this notice and the draft IEE prior to concluding our NEPA process or making a final decision on the IHA request.

Summary of Request

On December 29, 2020, NMFS received a request from the National Science Foundation (NSF) for an IHA to take marine mammals incidental to construction activities associated with the Palmer Station Pier Replacement Project on Anvers Island, Antarctica. NSF submitted several revisions of the application until it was deemed adequate and complete on July 15, 2021. NSF's request is for take of a small number of 17 species of marine mammals by Level B harassment and/or Level A harassment. Neither NSF nor NMFS expects serious injury or mortality to result from this activity and, therefore, an IHA is appropriate.

Description of Proposed Activity

Overview

The purpose of the project is to construct a replacement pier at Palmer Station on Anvers Island, Antarctica for the United States Antarctic Program. It is severely deteriorated, and needs to be replaced as soon as possible. Construction of the replacement pier and removal of the existing pier will require down-the-hole (DTH) pile installation, and vibratory pile removal. Limited impact driving will occur only to proof piles after they have been installed. The proposed project is expected to take up to 89 days of in-water work and will include the installation of 52 piles and removal of 36 piles. Construction is expected to begin no later than November 2021, depending on local sea ice conditions, and would be completed by mid-April 2022. The pile driving and removal activities can result in take of marine mammals from sound in the water which results in behavioral harassment or auditory injury. Note that hereafter (unless otherwise specified) the term "pile driving" is used to refer to both pile installation (including DTH pile installation) and pile removal.

Dates and Duration

The work described here is likely to begin in October or November 2021 and would be completed by mid-April 2022 with demobilization occurring no later than June of 2022. The construction season is limited due to ice and weather. Construction work cannot begin until the sea ice has vacated Hero Inlet and work must be completed prior to the return of sea ice so that personnel and equipment can be safely demobilized. The proposed IHA would be effective for a period of one year from October 1, 2021 through September 30, 2022. In-water activities will occur during daylight hours only. Work would be conducted 7 days per week for 12 hours (hr) per day and up to 89 days of in-water construction is anticipated.

Specific Geographic Region

The activities would occur at Palmer Station on Hero Inlet, between Gamage Point and Bonaparte Point on the southwestern coast of Anvers Island in the Antarctica Peninsula (Figure 1). The coordinates for the station are: 64°46' S, 64°03' W. Substrate at the project location consists of solid rock. In addition to the pier, there are several buildings, plus two large fuel tanks, and a helicopter pad. The area frequently experiences high winds, up to 130 kilometers (km) per hour, or greater. Palmer Station lies outside the Antarctic Circle, so there are 19 hours of light and 5 hours of twilight at the height of austral summer and only 5 hours of daylight each day in the middle of austral winter. Hero Inlet is a narrow inlet (approximately 135 meters (m) wide) along the southwest side of Anvers Island. Maximum observed tidal range is 2.5 m with mean sea level at 0.72 m. The shoreline and upland area is generally rocky or exposed bedrock. Ice cliffs rise above the station.

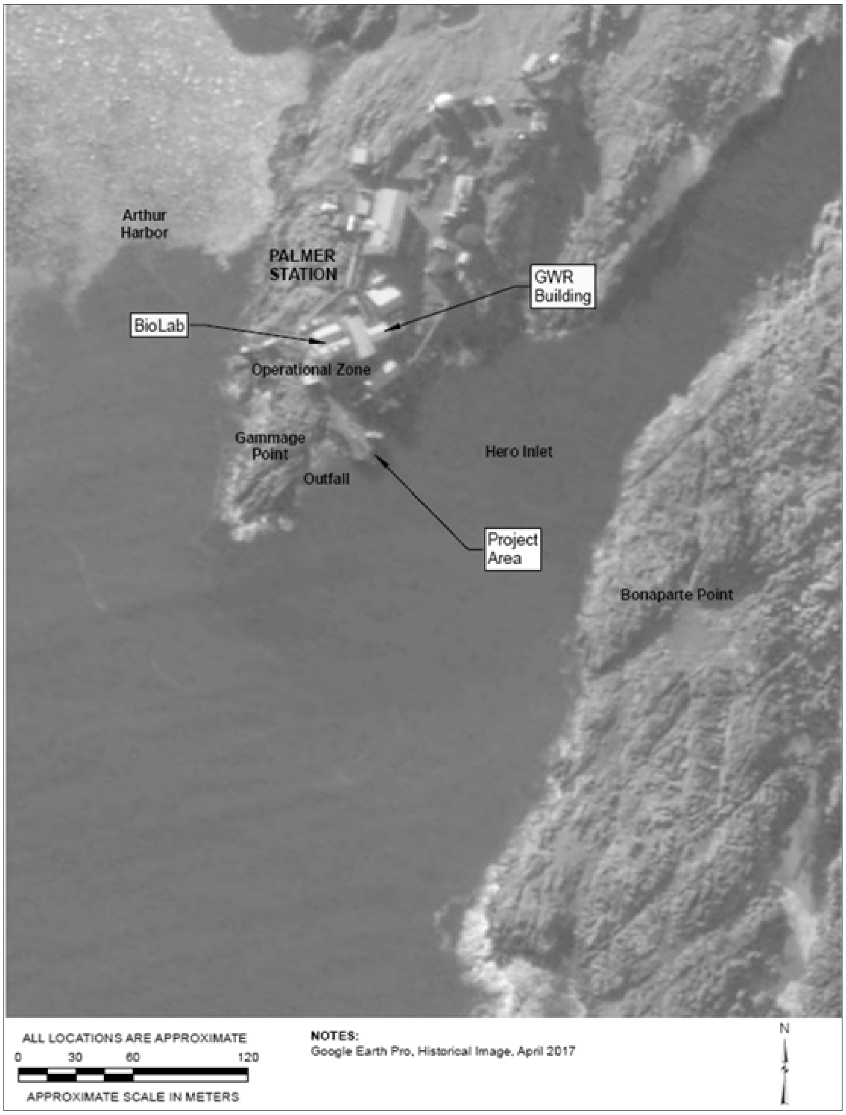

Figure 1. Map of Proposed Project Area

Detailed Description of Specific Activity

The existing pier at Palmer Station consists of a sheetpile bulkhead backfilled with gravel and cobble that was built in 1967. It is severely deteriorated, and needs to be replaced as soon as possible.

This project would replace the existing pier with a new steel pipe pile supported concrete deck pier, new modern energy absorbing fender system and on-site power and lighting. Work on the fendering system would be above water. In-water work with the potential to produce underwater noise includes demolition of the existing pier, construction of the new pier and installation of wave attenuator piles. While piles for the wave attenuator will be installed in this project, the wave attenuator itself would be installed later. (NMFS does not expect installation of the wave attenuator to result in take.)

The existing bulkhead pier must be demolished prior to construction of the new pier. The existing sheetpile cofferdam bulkhead would be demolished and the sheets would be removed by a vibratory hammer or cut off at the mudline. Sheet pile removed from the pier cell would be loaded onto the material barge for disposal. A pier cell is a structure that has hollow sections (*i.e.* cells).

New pile installation would include steel gravel-filled pipe piles as outlined in Table 1. The deck and pile caps for the pier are supported by the piles, which are installed in holes (sockets) created in the shallow bedrock by the DTH systems. Support vessels, including a tugboat, one stationary barge, a temporary floating construction platform, a 16-ft. (5-m) skiff and one 200 horsepower work boat would be used for the duration of the project to complete in-water work. A separate gravel barge would deliver material at the beginning of the project, but would only be onsite for approximately 3 days.

Table 1. Pile Summary

Structure	Size and Type of Pile	Socket Depth (feet [ft]))	Number of Piles
Pier Abutment	32 or 36-in. diameter steel pile in approximate 38-in. diameter holes	30	4
Pier	36-in. steel pile in approximate 38-in. diameter holes	20	Up to 18[a]
Retaining Wall	H pile inserted in 24-in. diameter hole	10	Up to 9[a]
Wave Attenuator Piles	24-in. steel pile	20	2
Rigid Hull Inflatable Boat Fender	24-in. steel pile	20	3
Template Piles (temporary)	24-in. steel pile	10	32[b]
Sheetpile Removal	3/8-in	0	20

[a] Includes 2 piles as a contingency for design flexibility
b 16 of these piles are removed once they are no longer needed as templates

The primary source of underwater noise that may result in takes during construction would be from the installation and removal of piles to support the pier and fenders. Table 2 shows project components and activities that could result in the take of marine mammals.

Table 2. Project Components: Potential for Marine Mammal Take

Project Component	Equipment	Potential for Marine Mammal Take (Yes/No)
Pile/Sheetpile Removal	Excavator and loader operated above water	No
	Crane operated above water	No
	Vibratory hammer	Yes
	Underwater cutting tool[1]	Yes
Pile Installation	Crane operated above water	No
	DTH drill	Yes
	Impact hammer	Yes
	Vibratory hammer	Yes
Anode Protection	Pneumatic hydrogrinder or needle scaler[2]	Yes
Rock chipping (optional)	Hoe ram	Yes[3]

[1] Underwater cutting tool operation, if necessary, would occur on the same days as vibratory extraction. Estimated take associated with cutting tool operation was calculated by utilizing higher underwater source levels associated with vibratory extraction.
[2] These tools scrape off surfaces for rust, paint, etc. Use of these tools would be limited and would occur once pile installation is complete. Underwater source levels are estimated at 146 dB at 10m and have been accounted for in the take estimate.
[3]Rock chipping may not be necessary. However if it does occur it would occur on the same days as DTH pile installation.

Piles would be socketed in place since the substrate comprises rocky or exposed bedrock. This involves drilling and hammering into the rock to create a socket hole deeper and larger than the pile diameter. The primary technique for creating the socket holes and their piles would be by DTH pile installation. DTH installation uses both rotary and hammering actions on a drill bit (*i.e.*, like a hammer drill hand tool) to create a hole in the bedrock or sediment. It uses the rotation of the drill system and a (typically pneumatic) hammering mechanism to break up rock to create a hole. Since construction techniques could vary depending on specific site conditions, a small impact hammer may also need to be used at the end of the process to firmly seat the pile in the hole. This may require no more than 10 strikes. It is unlikely that a vibratory hammer would be used to install piles. Once the pile is set, the remaining void space is filled with a high-performance cement-based sealing grout. Temporary template piles used during construction would be removed with a vibratory hammer or cut off at the mudline.

Approximately one to two piles would be installed over a 12-hour work day. As a precautionary measure, it is assumed that two installation activities would be occurring at the same time (*i.e.,* simultaneous). The main method of pile installation would be by DTH. Two DTH systems would be available on site and could be used simultaneously. One vibratory hammer would possibly be used to remove existing piles, and one impact hammer could be used to proof piles.

Rock chipping may be required to ensure accurate pile location and alignment with the sea bottom at pile locations. Rock chipping involves the use of excavators fitted with hydraulic "breakers" or powerful percussion hammers used to break up large concrete structures. If rock chipping is necessary, it would likely occur prior to but on the same days as DTH pile installation.

The project design includes installation of anode corrosion protection for the major submerged steel components. Divers would install aluminum alloy anodes below the waterline by welding and using a pneumatic hydrogrinder, needle scaler, or similar equipment. They would use these tools to scrape rust, paint, etc. off surfaces. This activity would occur only after pile installation is complete. The hydrogrinder or needle scaler would only be used approximately one hour per day over an 18-day period;

Table 3 provides the number of piles and the estimated number of days of installation.

Table 3. Pile Installation and Removal Duration

Pile Type	Number of Piles	Total Days of Installation[1]
36-in. piles[2] (pier Bents 2, 3, and 4)	Up to 18	47
32-in. piles (pier abutment Bent 1)	4	

24-in. RHIB (rigid hull inflatable boat) fender	3	16
24-in. template piles	16	
24-in. retaining wall	2	
24-in. H piles (retaining wall)	Up to 9	
Pile Removal (24-in.)	16	4
Sheetpile Removal	20	4
Anode Installation	0	18
Rock chipping	0	
	Up to 88	89

[1]This is a conservative estimate. It is possible that 24-in. piles may be driven on the same day as 36-in. piles. If this occurs, overall days may be reduced for pile installation.
[2] For the purposes of calculating take, there is reference to Scenario 1A which involves pile installation of two 36-in piles simultaneously. In this table, Scenarios 1 and 1A are synonymous in terms of representing the number of estimated days for installation.

Description of Marine Mammals in the Area of Specified Activities

Table 4 lists all species or stocks for which take is expected and proposed to be authorized for this action, and summarizes best available information on the population or stock, including regulatory status under the MMPA and Endangered Species Act. For taxonomy, we follow Committee on Taxonomy (2020). Marine mammals in the Project Area do not constitute stocks under U.S. jurisdiction; therefore, there are no stock assessment reports. Additional information on these species may be found in Section 3 of NSF's application.

For species occurring in United States Antarctic Marine Living Resources (AMLR) survey area of the Southern Ocean, the International Union for the Conservation of Nature (IUCN) status is provided. The IUCN systematically assesses the relative risk of extinction for terrestrial and aquatic plant and animal species via a classification scheme using five designations, including three threatened categories (Critically Endangered, Endangered, and Vulnerable) and two non-threatened categories (Near Threatened and Least Concern) (*www.iucnredlist.org/*; accessed June 10, 2021). These assessments are generally made relative to the species' global status, and therefore may have limited applicability when marine mammal stocks are defined because we analyze the potential population-level effects of the specified activity to the relevant stock.

However, where stocks are not defined, IUCN status can provide a useful reference.

Table 4. Marine Mammals Potentially Present in the Vicinity of the Project Area

Common name	Scientific name	Stock[2]	ESA/MMPA/IUCN status[3]	Abundance (CV)[4]
Order Cetartiodactyla – Cetacea – Superfamily Mysticeti (baleen whales)				
Family Balaenidae (right whales)				
Southern right whale	*Eubalaena australis*		E/D/LC	1,755 (0.62)[5]
Family Balaenopteridae (rorquals)				
Humpback whale	*Megaptera novaeangliae australis*		E/D/LC	9,484 (0.28)[5]
Antarctic minke whale	*Balaenoptera bonaerensis*		-/NT	18,125 (0.28)[5]
Fin whale	*B. physalus quoyi*		E/D/VU	4,672 (0.42)[5]
Blue whale	*B. musculus musculus*		E/D/EN	1,700[13]
Sei whale	*Balaenoptera borealis*		E/D/EN	626[14]
Superfamily Odontoceti (toothed whales, dolphins, and porpoises)				
Family Physeteridae				
Sperm whale	*Physeter macrocephalus*		E/D/VU	12,069 (0.17)[7]
Family Ziphiidae (beaked whales)				
Arnoux's beaked whale	*Berardius arnuxii*		/DD	Unknown
Southern bottlenose whale	*Hyperoodon planifrons*		-/LC	53,743 (0.12)[8]
Family Delphinidae				
Hourglass dolphin	*Lagenorhynchus cruciger*		-/LC	144,300 (0.17)[9]
Killer whale	*Orcinus orca*[1]		-/DD	24,790 (0.23)[8]
Long-finned pilot whale	*Globicephala melas edwardii*		-/LC	200,000 (0.35)[9]
Order Carnivora – Superfamily Pinnipedia				
Family Otariidae (eared seals and sea lions)				
Antarctic fur seal	*Arctocephalus gazella*	South Georgia	-/LC	2,700,000[10]
Family Phocidae (earless seals)				
Southern elephant seal	*Mirounga leonina*	South Georgia	-/LC	401,572[11]
Weddell seal	*Leptonychotes weddellii*		-/LC	500,000-1,000,000[12]
Crabeater seal	*Lobodon carcinophaga*		-/LC	5,000,000-10,000,000[12]
Leopard seal	*Hydrurga leptonyx*		-/LC	222,000-440,000[12]

[1]Three distinct forms of killer whale have been described from Antarctic waters; referred to as types A, B, and C, they are purported prey specialists on Antarctic minke whales, seals, and fish, respectively (Pitman and Ensor, 2003; Pitman *et al.*, 2010).
[2]For most species in the AMLR, stocks are not delineated and entries refer generally to individuals of the species occurring in the research area.
[3]Endangered Species Act (ESA) status: Endangered (E), Threatened (T)/MMPA status: Depleted (D). A dash (-) indicates that the species is not listed under the ESA or designated as depleted under the MMPA. Any species listed under the ESA is automatically designated under the MMPA as depleted. IUCN status: Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DD).
[4]CV is coefficient of variation. All abundance estimates, except for those from Reilly *et al.,*(2004) (right, humpback, minke, and fin whales), are for entire Southern Ocean (*i.e.*, waters south of 60°S) and not the smaller area comprising the Southwest Fisheries Science Center (SWFSC) research area.
[5]Abundance estimates reported in Reilly *et al.,*(2004) for the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) survey area from 2000. Surveys include Antarctic Peninsula (473,300 km^2) and Scotia Sea (1,109,800 km^2) strata, which correspond roughly to SWFSC's Antarctic Research Area (ARA), as reported by Hewitt *et al.,* (2004).
[6]Southern Ocean abundance estimate (Branch *et al.*, 2007).
[7]Southern Ocean abundance estimate (IWC, 2001 in Whitehead, 2002).
[8]Southern Ocean abundance estimate from circumpolar surveys covering 68 percent of waters south of 60°S from 1991-98 (Branch and Butterworth, 2001).
[9]Southern Ocean abundance estimate derived from surveys conducted from 1976-88 (Kasamatsu and Joyce, 1995).

[10]South Georgia abundance estimate; likely >95 percent of range-wide abundance (Forcada and Staniland, 2009). Genetic evidence shows two distinct population regions, likely descended from surviving post-sealing populations at South Georgia, Bouvetøya, and Kerguelen Islands (Wynen *et al.*, 2000; Forcada and Staniland, 2009). Individuals from the South Georgia population (including breeding populations at the South Orkney and South Shetland Islands, which are within the ARA) are likely to occur in the ARA.
[11]Four genetically distinct populations are recognized: the Peninsula Valdés population in Argentina, the South Georgia population in the South Atlantic Ocean, the Kerguelen population in the South Indian Ocean and the Macquarie population in the South Pacific Ocean (Slade *et al.*, 1998; Hoelzel *et al.*, 2001). Animals occurring in ARA are likely to belong to South Georgia population, which includes subpopulations at South Georgia Island (>99 percent of population) and at the South Orkney and South Shetland Islands; South Georgia population abundance estimate from 2001 (McMahon *et al.*, 2005).
[12]Range-wide abundance estimates (Thomas and Terhune, 2009; Bengtson, 2009; Rogers, 2009).
[13] Southern Ocean abundance estimate (Branch *et al.*, 2007). CI is confidence interval.
[14] South of 60°S

Antarctic Minke Whale

Antarctic minke whales are similar in shape and coloration to the more global species of minke whale (*B. acutorostrata*). The two species differ in relative size and shape of several cranial features, and Antarctic minke whales lack the distinct white flipper mark of the more common minke whale.

The seasonal distribution and migration patterns of nearly all populations of minke whales are poorly understood (Risch *et al.,* 2019). Antarctic minke whales are abundant from 60ºS to the ice edge during the austral summer then retreat in the austral winter to breeding grounds in mid-latitudes in the Pacific and other locations off Australia and South Africa. Antarctic minke feed mainly on euphausiids (krill (*Euphausia superba*)). This species is highly associated with sea ice and is generally less abundant in ice-free waters. In general, minke whales are commonly observed alone or in small groups of two or three individuals. Aggregations of up to 400 may form on occasion in high latitudes. During the feeding season, mature females are found closer to the ice than immature females, and immature males are more solitary than mature males.

Over the period January 21, 2019 through March 31, 2020, one minke whale was observed during bird observation studies at Palmer Station in Arthur Harbor, which is on the other side of the peninsula separated from Hero Inlet. The whale was observed feeding about 300 m offshore. A lead Principal Investigator studying marine mammals as part of the Long-Term Ecological Research Program at Palmer Station notes minke whales are common within a few miles of the station (Ari Friedlander, personal communication).

Fin Whale

Fin whales are closely related to blue and sei whales. Northern and southern populations remain separated leading to genetic isolation of the populations. The fin whale is found in most large water masses of the world, from tropical to polar regions. However, in the most extreme latitudes individuals may be absent near the ice limit. Overall, fin whale densities in the southern hemisphere tend to be higher outside the continental slope than inside it.

Fin whales feed on an assortment of prey items, depending on their availability (Kawamura 1980; as cited in Wursig *et al.,* 2018); their diet varies with season and locality. Southern Hemisphere fin whales have a diet of almost exclusively krill, and other planktonic crustaceans. In the Southern Hemisphere, fin whales seasonally migrate north to south; they feed in the summer at high latitudes and breed and fast in the winter at low latitudes.

One fin whale was recently seen within a few miles of the station (Ari Friedlander, personal communication).

Blue Whale

Blue whales in the Southern Hemisphere are on average larger than those in the Northern Hemisphere. Blue whales are a cosmopolitan species with North Atlantic, North Pacific, and Southern hemisphere populations. They were historically most abundant in the Southern Ocean, but are very rare today in the Project Area. Due to food availability they are found predominantly offshore. Blue whales feed almost exclusively on euphausiids in areas of cold water upwelling.

Sei Whale

Sei whales inhabit all ocean basins; they are oceanic and not commonly found in shelf seas. Sei whales migrate seasonally, spending the summer months feeding in the subpolar higher latitudes and returning to the lower latitudes to calve in winter. In the Southern Hemisphere, they are rarely found as far south as blue, fin, and minke whales, with summer concentrations mainly between the subtropical and Antarctic convergences (between 40ºS and 50ºS). Sei feed on copepods, euphausiids, shoals of fish, and squid if they are encountered.

Hourglass Dolphin

Hourglass dolphins are pelagic and circumpolar in the Southern Ocean; they are found in Antarctic and sub-Antarctic waters. Most sightings of live hourglass dolphins reflect observer effort, and are centered on the Antarctic convergence with most sightings from the Drake Passage. Hourglass dolphins often feed in large aggregations of seabirds such as great shearwaters and black-browed albatrosses, and in plankton slicks (White *et al.,* 1999; as cited in Wursig *et al.,* 2018). Their prey items include small fish (about 2.4 g and a length of 55 mm), small squid, and crustaceans. They are believed to feed in surface waters.

Migratory movements of this species are not well known. It is thought that hourglass dolphins from the Antarctic convergence zone and the continental shelf break may move into sub-Antarctic waters in winter. Thus, the range of the species thus probably shifts north and south with the seasons (Carwardine 1995; as cited in Wursig *et al.,* 2018). Although oceanic, hourglass dolphins are often observed near islands and banks, in areas with turbulent waters; they have been observed in the Project Area (Ari Friedlander, personal communication).

Humpback Whale

Humpback whales are distributed throughout the world. They are highly migratory, spending spring through fall on feeding grounds in mid- or high-latitude waters, and wintering on calving grounds in the tropics, where they do not eat (Dawbin 1966; as referenced in Wursig *et al.,* 2018). Seven populations of humpback whales are found in the Southern hemisphere and feed throughout the waters off Antarctica. In the Southern Hemisphere, humpback whales feed in circumpolar waters and migrate to breeding grounds in tropical waters to the north. Seven breeding populations are recognized by the International Whaling Commission in the Southern Hemisphere, and these are linked to six feeding areas in the Antarctic. Bettridge *et al.,* (2015) identify the southeast Pacific breeding stock as feeding in waters to the west of the Antarctic Peninsula where Palmer station is located. These animals breed in the Pacific-Central America waters.

Humpback whales are considered generalists, feeding on euphausiids and various species of small schooling fish. They appear to be unique among large whales in their use of bubbles to corral or trap these schooling fish.

Humpback whales are the most common whale seen within a few miles of the station (Ari Friedlander, personal communication). From January 21, 2019 through March 31, 2020, marine mammal sightings have been recorded during bird observation studies at Palmer Station. On January 23, 2019, three humpback whales (two adults and one juvenile) were observed feeding off Torgersen Island, and one adult and one juvenile were observed feeding in Arthur Harbor on January 26, 2019. Several groups of up to four individuals (likely adults and juveniles) were observed feeding in Arthur Harbor in early February 2019. No humpbacks were observed after February 12. At the end of May 2019, two humpback whales were again observed near Bonaparte Point, with no other sightings until the end of December 2019 when one humpback was observed feeding in Arthur Harbor. In late December 2019 through early February 2020, individual whales or groups of two adults and possibly a juvenile feeding in Arthur Harbor were recorded on

10 separate occasions. A large group of five whales (four adults and a juvenile) was observed in Arthur Harbor on March 3, 2020. This was the last sighting recorded.

Killer Whale

The killer whale is found in all the world's oceans and most seas. It is the largest member of the family Delphinidae and has very distinctive black-and-white coloration. Antarctic killer whales make periodic rapid long-distance migrations to subtropical waters, possibly for skin maintenance (Durban and Pitman 2011; as referenced in Wursig *et al.,* 2018). Killer whales are social animals that are usually observed traveling in groups containing a few to 20 or more individuals. Reports of larger groups usually involve temporary aggregations of smaller, more stable social units.

Currently only one species of killer whale is recognized (*O. orca*), but it is likely that some of genetically distinct forms found in different regions of the world represent distinct species (Wursig *et al.,* 2018). In the Antarctic, five distinct forms of killer whale have been identified: types A, B1, B2, C, and D. They differ in coloration, morphology, and in some cases diet (Pitman and Ensor 2003). Types B1 and B2 are the most common form observed around the Antarctic Peninsula and Anvers Island (Durban *et al.,* 2016).

Killer whales prey on a wide range of vertebrates and invertebrates; they have no natural predators other than humans. It is the only cetacean that routinely preys upon marine mammals, with attacks or kills documented for 50 different species. Mammalian taxa that are prey of killer whales include other cetaceans—both mysticetes and odontocetes—pinnipeds, sirenians, mustelids and, on rare occasions, ungulates. A variety of fish species are also important food of killer whales. In the Antarctic, killer whales in open water prey on Antarctic minke whales, seals, and fish.

Killer whales are commonly observed within a few miles of the station (Ari Friedlander, personal communication).

Long-Finned Pilot Whale

Long-finned pilot whales inhabit the cold temperate waters of both the North Atlantic and the Southern Ocean. They are circumpolar in the Southern Hemisphere and occur as far north as 14° S in the Pacific and south to the Antarctic Convergence (Olson 2009). Pilot whales are found in both nearshore and pelagic environments. Pilot whales are generally nomadic, but are highly social and are usually observed in schools of several to hundreds of animals. They also have been observed in mixed species aggregations. Their diet consists mostly of squid and other cephalopods, with smaller amounts of fish. Pilot whales are known to dive deep for prey; the maximum dive depth measured is about 1,000 m.

Arnoux's Beaked Whale

Arnoux's beaked whales inhabit vast areas of the Southern Hemisphere, between 24°S and Antarctica. They are a deep diving species and can be found in areas of heavy ice cover. Little is known of the diet of Arnoux's beaked whales but one individual's stomach was found to be mostly filled with squid beaks (Wursig *et al*. 2018). Arnoux's beaked whales often occur in groups of 6-10 and occasionally up to 50 or more (Balcomb 1989). Arnoux's beaked whales have been observed in the Project area. Because they are heavily ice-associated Arnoux's, beaked whales may be directly affected by loss of sea ice due to climate change.

Southern Bottlenose Whale

Southern bottlenose whales are widely distributed throughout the Southern Hemisphere, mainly south of 30°S, and are most common between 58°S and 62°S. Bottlenose whales seem to prefer deeper waters and, like other beaked whales, they make regular deep dives to forage. Stomach content analyses of six southern bottlenose whales show that this species feeds primarily on squid (MacLeod *et al.,* 2003). Bottlenose whales are typically observed in small groups of up to 10 individuals, though groups of up to 20 animals of mixed age/sex classes have been reported. Social behaviors have not been studied in southern bottlenose whales.

Southern Right Whale

Southern right whales are found between 20°S and 60°S. Right whales are "skimmers" (Baumgartner *et al.,* 2007; as cited in Wursig *et al.,* 2018). They feed offshore in pelagic regions in areas of high productivity by swimming forward with the mouth agape. Feeding can occur at or just below the surface, where it can be observed easily, or at depth. At times, right whales apparently feed very close to the bottom, because they are observed to surface at the end of an extended dive with mud on their heads. Typical feeding dives last for 10–20 min. It is likely that krill comprise a high proportion of the diet in southern right whales.

Sperm Whale

Sperm whales are widely distributed, but distribution of the sexes are different. Female sperm whales almost always inhabit water deeper than 1,000 m and at latitudes less than 40°S, corresponding roughly to sea surface temperatures greater than 15°C. Sperm whales dive to about 600 m below the surface where they hunt primarily for squid. Distribution and relative abundance can vary in response to prey availability, most notably squid (Jaquet & Gendron 2002).

Large males from high latitudes can be found in almost any ice-free deep water. Therefore, any sperm whales encountered in Antarctic waters are highly likely to be male. They are more likely to be sighted in productive waters, such as those along the edges of continental shelves. Sperm whales have low birth rates, slow growth and high survival rates.

Antarctic Fur Seal

Antarctic fur seals have a circumpolar distribution. They are found from the Antarctic continent to the Falkland Islands. Land-based breeding strongly influences the distribution of females and their foraging ecology. Lactating females are restricted to foraging in the waters immediately surrounding the breeding beaches, whereas males can disperse after mating. Female distribution expands after breeding as they leave rookeries.

Antarctic krill dominates the diet of Antarctic fur seals in the vicinity of the Project Area. Penguins are occasionally taken by Antarctic fur seal bulls. Killer whales are likely the main predator of the species, but leopard seals are thought to limit the population growth at Elephant Island in the South Shetland Islands. Large bulls of other species also prey on pups where species coexist.

Over three seasons from 2019 through 2020 (*i.e.*, two Antarctic summers and one winter), marine mammal sightings have been recorded during daily bird observation studies at Palmer Station. A total of 73 fur seals were observed either hauled out or swimming in Hero Inlet during the Antarctic summer months between January and March 2019. Over a longer summer period between October 2019 and March 2020, there were 242 seals observed in Hero Inlet, with the majority of seals hauled out (see Table 6-1 in application). During the winter months between March and October 2019, 70 seals were observed in Hero Inlet. Fewer fur seals were observed over the same 2019 – 2020 months in Arthur Harbor. See Section 6 of the application for additional details on seal observations in the project vicinity (NSF, personal communication).

Crabeater Seal

Crabeater seals have a circumpolar Antarctic distribution; they spend the entire year in pack ice. They move over large distances with the annual advance and retreat of pack ice. Although they can be found anywhere within the pack ice zone, they are typically found at the edge of the continental shelf, as well as in the marginal ice zone (Burns *et al.,* 2004 and Southwell *et al.,* 2005; as referenced in Wursig *et al.,* 2018). Crabeater seals sometimes congregate in large groups of up to several hundred, which might be associated with general patterns of seasonal movement or foraging. As with other Antarctic seals, crabeater seals have a daily haul out pattern in summer that generally involves hauling out on ice floes during the middle of the day (Bengtson and Cameron, 2004; as referenced in Wursig *et al.,* 2018), though usually less than 80 percent are hauled out on the ice at the same time.

Antarctic krill is the primary prey item for crabeater seals, constituting over 95 percent of their diet. They also eat small quantities of fish and squid (Øritsland, 1977; as referenced in Wursig *et al.,* 2018). Crabeater seals do not appear to seasonally switch prey. During daily nocturnal foraging periods in summer, crabeater seals will nearly continuously dive for up to 16 h at a time.

Over three seasons (*i.e.*, two Antarctic summers and one winter) from January 21, 2019 through March 31, 2020, marine mammal sightings have been recorded during bird observation studies at Palmer Station. Crabeater seals were commonly observed individually or in small groups lying on the ice in Arthur Harbor and Hero Inlet in late January and February of 2019; the frequency of sightings decreased by March. Groups of up to four individuals were observed in or near the Project Area in early April of 2019, some were lying on the floating dock. Groups of crabeater seals were observed swimming in Hero Inlet near Gamage Point in April and early May of 2019. No crabeater seals were recorded in June, but in early July of 2019 groups of two seals and individuals were observed on the ice at Arthur Harbor and Hero Inlet, and on the shore at Bonaparte Point. No crabeater seals were observed from mid-July to mid-October of 2019. Observations of crabeater seals increased in Arthur Harbor frequency into November of 2019, with sightings continuing into December. However, from January of 2020 through March of 2020, crabeater seals were only observed on nine occasions; this was less frequent than sightings recorded from January to March of 2019 (NSF, personal communication).

Southern Elephant Seal

Southern elephant seals are the largest of all pinnipeds. Southern elephant seals can be divided into three distinct stocks: Maguire Island, Iles Kerguelen, and South Georgia, the latter of which is relevant to the Project Area. There is some separation of feeding areas between the sexes, with males tending to feed more in continental shelf waters, while females either use ice-free waters broadly associated with the Antarctic Polar Front, or the marginal ice zone, moving northward as the ice expands. Elephant seals prey on deepwater and bottom dwelling organisms, including fish, squid, crab, and octopus. They are extraordinary divers with some dive depths exceeding 1,500 m and lasting up to 120 minutes.

Over three seasons (two Antarctic summers and one winter) from January 21, 2019 through March 31, 2020, one elephant seal was observed lying on shore near Palmer Station in early March of 2019. No other seals were observed again until October of 2019 when on six days over the period October 8 to 19, 2019 a single seal was observed lying on the ice in Arthur Harbor. Additional sightings were noted in November and December 2019 in Hero Inlet. Sightings increased from January 6 to February 10, 2020, when elephant seals were observed at Bonaparte Point as individuals or in groups as large as 7 nearly every day and sometimes several times a day. No elephant seals were observed after February 10, 2020. This is noticeably different than 2019, when no elephant seals were observed in January or February (NSF, personal communication).

Leopard Seal

The leopard seal (*Hydrurga leptonyx*) is the largest Antarctic pack ice seal. Leopard seals are solitary pinnipeds, and are widely dispersed at low densities on the circumpolar Antarctic pack ice (Rogers *et al.,* 2013; as cited in Wursig *et al.,* 2018). Most of the leopard seal population remains within the pack ice, but when the sea ice extent is minimal, leopard seals are restricted to coastal habitats (Meade *et al.,* 2015; as cited in Wursig *et al.,* 2018).

These seals prey on penguins, other marine mammals, and zooplankton; this combination of apex predator and planktivore is unique for marine mammals. Due to the size of their mouth, leopard seals can take large-bodied prey including crabeater, Weddell, southern elephant seals, and fur seals.

During three seasons (two Antarctic summers and one winter) of observation studies at Palmer Station, single leopard seals were occasionally observed lying on the ice in Arthur Harbor or swimming in Hero Inlet starting in late January until April of 2019. One additional sighting was recorded in July, and no leopard seals were observed again until November 19, 2019, when three were observed on the ice in Arthur Harbor. Occasional sightings continued from November 2019 through March of 2020. On March 31, a leopard seal was observed feeding on a crabeater seal in Hero Inlet (NSF, personal communication).

Weddell Seal

Weddell seals are large pinnipeds weighing up to 600 kg with typical weights between 300 and 500 kg. Weddell seals aggregate on the ice to molt, and also sporadically dive during this period. After molting in fall-winter these seals disperse to sea; some individuals remain within the vicinity of their colonies, whereas other individuals disperse several hundreds of kilometers away and may not return to their colonies for several weeks.

The Weddell seal's range includes coastal areas around the Antarctic continent and they are found in areas of both fast and pack ice. Weddell seals rarely venture into open, ice-free waters. Animals inhabiting the islands of the mostly ice-free northern Antarctic Peninsula are primarily coastal in their distribution.

Weddell seals consume epipelagic (0–200 m), mesopelagic (200–1000 m) and benthic prey. They can dive to depths over 600 m to reach the deeper prey items. Their diet consists mainly of fish but they also eat cephalopods, decapods and Antarctic krill.

Their feeding/haul out pattern is diurnal; they haulout during the day and forage at night in response to the vertical migration of their prey (Andrews-Goff *et al.,* 2010; as cited in Wursig *et al.,* 2018).

Over three seasons (two Antarctic summers and one winter) of observation from January 21, 2019 through March 31, 2020, individual Weddell seals were observed on shore at Bonaparte Point from the end of February of 2019 through April of 2019. Weddell seals were observed swimming in Hero Inlet in early April 2019 on several occasions. No Weddell seals were sighted again until mid-September of 2019, when an individual was again observed on the ice in Hero Inlet. After September 16, 2019, no Weddell seals were observed in the vicinity of Palmer Station until January 6, 2020; at that time a seal was observed in the vicinity of the outfall. As with 2019 observations, Weddell seal sightings at Bonaparte Pointe increased in mid- to late February of 2020, and continued every day or every few days through March 27, 2020.

As indicated above, all 17 species in Table 4 temporally and spatially co-occur with the activity to the degree that take is reasonably likely to occur, and we have proposed authorizing it.

Marine Mammal Hearing

Hearing is the most important sensory modality for marine mammals underwater, and exposure to anthropogenic sound can have deleterious effects. To appropriately assess the potential effects of exposure to sound, it is necessary to understand the frequency ranges marine mammals are able to hear. Current data indicate that not all marine mammal species have equal hearing capabilities (*e.g.*, Richardson *et al.*, 1995; Wartzok and Ketten, 1999; Au and Hastings, 2008). To reflect this, Southall *et al.* (2007) recommended that marine mammals be divided into functional hearing groups based on directly measured or estimated hearing ranges on the basis of available behavioral response data, audiograms derived using auditory evoked potential techniques, anatomical modeling, and other data. No direct measurements of hearing ability have been successfully completed for mysticetes (*i.e.*, low-frequency cetaceans). Subsequently, NMFS (2018) described generalized hearing ranges for these marine mammal hearing groups. Generalized hearing ranges were chosen based on the approximately 65 decibel (dB) threshold from the normalized composite audiograms, with the exception for lower limits for low-frequency cetaceans where the lower bound was deemed to be biologically implausible and the lower bound from Southall *et al.,* (2007) retained. Marine mammal hearing groups and their associated hearing ranges are provided in Table 5.

Table 5. Marine Mammal Hearing Groups (NMFS, 2018)

Hearing Group	Generalized Hearing Range*
Low-frequency (LF) cetaceans (baleen whales)	7 Hz to 35 kHz
Mid-frequency (MF) cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)	150 Hz to 16 kHz
High-frequency (HF) cetaceans (true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*)	275 Hz to 160 kHz
Phocid pinnipeds (PW) (underwater) (true seals)	50 Hz to 86 kHz
Otariid pinnipeds (OW) (underwater) (sea lions and fur seals)	60 Hz to 39 kHz

* Represents the generalized hearing range for the entire group as a composite (*i.e.,* all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range chosen based on ~65 dB threshold from normalized composite audiogram, with the exception for lower limits for LF cetaceans (Southall *et al.,* 2007) and PW pinniped (approximation).

The pinniped functional hearing group was modified from Southall *et al.* (2007) on the basis of data indicating that phocid species have consistently demonstrated an extended frequency range of hearing compared to otariids, especially in the higher frequency range (Hemilä *et al.*, 2006; Kastelein *et al.*, 2009; Reichmuth and Holt, 2013).

For more detail concerning these groups and associated frequency ranges, please see NMFS (2018) for a review of available information. Of the seventeen marine mammal species that may be present, six are classified as low-frequency cetaceans (*i.e.*, all mysticete species), five are classified as mid-frequency cetaceans (*i.e.*, all delphinid and ziphiid species and the sperm whale), one is classified as a high-frequency cetacean species (*i.e.*, hourglass dolphin.) and there is one species of otariid and 4 phocids.

Potential Effects of Specified Activities on Marine Mammals and their Habitat

This section includes a summary and discussion of the ways that components of the specified activity may impact marine mammals and their habitat. The **Estimated Take** section later in this document includes a quantitative analysis of the number of individuals that are expected to be taken by this activity. The **Negligible Impact Analysis and Determination** section considers the content of this section, the **Estimated Take** section, and the **Proposed Mitigation** section, to draw conclusions regarding the likely impacts of these activities on the reproductive success or survivorship of individuals and how those impacts on individuals are likely to impact marine mammal species or stocks.

Acoustic effects on marine mammals during the specified activity can occur from the underwater noise resulting from DTH pile installation, vibratory hammer removal, limited impact driving to seat piles, rock chipping, and the use of a hydrogrinder. The effects of underwater noise from NSF's proposed activities have the potential to result in Level A or Level B harassment of marine mammals in the Project Area.

Description of Sound Sources

The primary relevant stressor to marine mammals from the proposed activity is the introduction of noise into the aquatic environment; therefore, we focus our impact analysis on the effects of anthropogenic noise on marine mammals. To better understand the potential impacts, we describe sound source characteristics below. Specifically, we look at the following two ways to characterize sound: by its temporal (*i.e.*, continuous or intermittent) and its pulse (*i.e.,* impulsive or non-impulsive) properties. Continuous sounds are those whose sound pressure level remains above that of the ambient sound, with negligibly small fluctuations in level (NIOSH, 1998; ANSI, 2005), while intermittent sounds are defined as sounds with interrupted levels of low or no sound (NIOSH, 1998). Impulsive sounds, such as those generated by impact pile driving, are typically transient, brief (< 1 sec), broadband, and consist of a high peak pressure with rapid rise time and rapid decay (ANSI, 1986; NIOSH, 1998). The majority of energy in pile impact pulses is at frequencies below 500 hertz (Hz). Impulsive sounds, by definition, are intermittent. Non-impulsive sounds, such as those generated by vibratory pile removal can be broadband, narrowband or tonal, brief or prolonged, and typically do not have a high peak sound pressure with rapid rise/decay time that impulsive sounds do (ANSI, 1995; NIOSH, 1998). Non-impulsive sounds can be intermittent or continuous. Similar to impact pile driving, vibratory pile driving generates low frequency sounds. Vibratory pile driving is considered a non-impulsive, continuous source. DTH is a hybrid source- the rotary drill action produces non-impulsive, continuous sounds while the hammer function produces impulsive sounds. Discussion on the appropriate harassment threshold associated with these types of sources based on these characteristics can be found in the **Estimated Take** section.

Potential Effects of Pile Driving

In general, the effects of sounds from pile driving to marine mammals might result in one or more of the following: temporary or permanent hearing impairment, non-auditory physical or physiological effects, behavioral disturbance, and masking (Richardson *et al.,* 1995; Nowacek *et al.,* 2007; Southall *et al.,* 2007). The potential for and magnitude of these effects are dependent on several factors, including receiver characteristics (*e.g.*, age, size, depth of the marine mammal receiving the sound during exposure); the energy needed to drive the pile (usually related to pile size, depth driven, and substrate), the standoff distance between the pile and receiver; and the sound propagation properties of the environment.

Impacts to marine mammals from pile driving activities are expected to result primarily from acoustic pathways. As such, the degree of effect is intrinsically related to the received level and duration of the sound exposure, which are in turn influenced by the distance between the animal and the source. The further away from the source, the less intense the exposure should be. The type of pile driving also influences the type of impacts, for example, exposure to impact pile driving or DTH may result in temporary or permanent hearing impairment, while auditory impacts are unlikely to result from exposure to vibratory pile driving. The substrate and depth of the habitat affect the sound propagation properties of the environment. Shallow environments are typically more structurally complex, which leads to rapid sound attenuation. In addition, substrates that are soft (*e.g.*, sand) absorb or attenuate the sound more readily than hard substrates (*e.g.*, rock) which may reflect the acoustic wave. Soft porous substrates also likely require less time to drive the pile, and possibly less forceful equipment, which ultimately decrease the intensity of the acoustic source.

Richardson *et al.* (1995) described zones of increasing intensity of effect that might be expected to occur, in relation to distance from a source and assuming that the signal is within an animal's hearing range. First is the area within which the acoustic signal would be audible (potentially perceived) to the animal, but not strong enough to elicit any overt behavioral or physiological response. The next zone corresponds with the area where the signal is audible to the animal and of sufficient intensity to elicit behavioral or physiological responsiveness. Third is a zone within which, for signals of high intensity, the received level is sufficient to potentially cause discomfort or tissue damage to auditory or other systems. Overlaying these zones to a certain extent is the area within which masking (*i.e.*, when a sound interferes with or masks the ability of an animal to detect a signal of interest that is above the absolute hearing threshold) may occur; the masking zone may be highly variable in size.

NMFS defines a noise-induced threshold shift (TS) as "a change, usually an increase, in the threshold of audibility at a specified frequency or portion of an individual's hearing range above a previously established reference level" (NMFS, 2016b). The amount of threshold shift is customarily expressed in dB (ANSI 1995, Yost 2007). A TS can be permanent (PTS) or temporary (TTS). As described in NMFS (2018), there are numerous factors to consider when examining the consequence of TS, including, but not limited to, the signal temporal pattern (*e.g.,* impulsive or non-impulsive), likelihood an individual would be exposed for a long enough duration or to a high enough level to induce a TS, the magnitude of the TS, time to recovery (seconds to minutes or hours to days), the frequency range of the exposure (*i.e.,* spectral content), the hearing and vocalization frequency range of the exposed species relative to the signal's frequency spectrum (*i.e.,* how animal uses sound within the frequency band of the signal; *e.g.*, Kastelein *et al.,* 2014), and the overlap between the animal and the source (*e.g.,* spatial, temporal, and spectral).

Permanent Threshold Shift - NMFS defines PTS as a permanent, irreversible increase in the threshold of audibility at a specified frequency or portion of an individual's hearing range above a previously established reference level (NMFS, 2018). Available data from humans and other terrestrial mammals indicate that a 40 dB threshold shift approximates PTS onset (see NMFS 2018 for review).

Temporary Threshold Shift – NMFS defines TTS as a temporary, reversible increase in the threshold of audibility at a specified frequency or portion of an individual's hearing range above a previously established reference level (NMFS, 2018). Based on data from cetacean TTS measurements (see Finneran 2015 for a review), a TTS of 6 dB is considered the minimum threshold shift clearly larger than any day-to-day or session-to-session variation in a subject's normal hearing ability (Schlundt *et al.,* 2000; Finneran *et al.,* 2000; Finneran *et al.,* 2002). As described in Finneran (2016), marine mammal studies have shown the amount of TTS increases with cumulative sound exposure level (SEL_{cum}) in an accelerating fashion: At low exposures with lower SEL_{cum}, the amount of TTS is typically small and the growth curves have shallow slopes. At exposures with higher SEL_{cum}, the growth curves become steeper and approach linear relationships with the noise SEL.

Depending on the degree (elevation of threshold in dB), duration (*i.e.*, recovery time), and frequency range of TTS, and the context in which it is experienced, TTS can have effects on marine mammals ranging from discountable to serious (similar to those discussed in auditory masking, below). For example, a marine mammal may be able to readily compensate for a brief, relatively small amount of TTS in a non-critical frequency range that takes place during a time when the animal is traveling through the open ocean, where ambient noise is lower and there are not as many competing sounds present. Alternatively, a larger amount and longer duration of TTS sustained during time when communication is critical for successful mother/calf interactions could have more serious impacts. We note that reduced hearing sensitivity as a simple function of aging has been observed in marine mammals, as well as humans and other taxa (Southall *et al.,* 2007), so we can infer that strategies exist for coping with this condition to some degree, though likely not without cost.

Schlundt *et al.* (2000) performed a study exposing five bottlenose dolphins and two beluga whales (same individuals as Finneran's studies) to intense one second tones at different frequencies. The resulting levels of fatiguing stimuli necessary to induce 6 dB or larger masked TTSs were generally between 192 and 201 dB re: 1 microPascal (μPa). Dolphins began to exhibit altered behavior at levels of 178–193 dB re: 1μPa and above; beluga whales displayed altered behavior at 180– 196 dB re: 1 μPa and above. At the conclusion of the study, all thresholds were at baseline values.

There are a limited number of studies investigating the potential for cetacean TTS from pile driving and only one has elicited a small amount of TTS in a single harbor porpoise individual (Kastelein *et al.*, 2015). However, captive bottlenose dolphins and beluga whales have exhibited changes in behavior when exposed to pulsed sounds (Finneran *et al.,* 2000, 2002, and 2005). The animals tolerated high received levels of sound before exhibiting aversive behaviors. Experiments on a beluga whale showed that exposure to a single watergun impulse at a received level of 207 kiloPascal (kPa) (30 psi) p-p, which is equivalent to 228 dB p-p, resulted in a 7 and 6 dB TTS in the beluga whale at 0.4 and 30 kHz, respectively. Thresholds returned to within 2 dB of the pre-exposure level within four minutes of the exposure (Finneran *et al.,* 2002). Although the source level of pile driving from one hammer strike is expected to be lower than the single watergun impulse cited here, animals being exposed for a prolonged period to repeated hammer strikes could receive more sound exposure in terms of SEL than from the single watergun impulse (estimated at 188 dB re 1 μPa^2-s) in the aforementioned experiment (Finneran *et al.,* 2002). Results of these studies suggest odontocetes are susceptible to TTS from pile driving, but that they seem to recover quickly from at least small amounts of TTS.

Behavioral Responses- Behavioral disturbance may include a variety of effects, including subtle changes in behavior (*e.g.*, minor or brief avoidance of an area or changes in vocalizations), more conspicuous changes in similar behavioral activities, and more sustained and/or potentially severe reactions, such as displacement from or abandonment of high-quality habitat. Disturbance may result in changing durations of surfacing and dives, number of blows per surfacing, or moving direction and/or speed; reduced/increased vocal activities; changing/cessation of certain behavioral activities (such as socializing or feeding); visible startle response or aggressive behavior (such as tail/fluke slapping or jaw clapping); avoidance of areas where sound sources are located.

Pinnipeds may increase their haul out time, possibly to avoid in-water disturbance (Thorson and Reyff, 2006). Behavioral responses to sound are highly variable and context-specific and any reactions depend on numerous intrinsic and extrinsic factors (*e.g.*, species, state of maturity, experience, current activity, reproductive state, auditory sensitivity, time of day), as well as the interplay between factors (*e.g.*, Richardson *et al.,* 1995; Wartzok *et al.,* 2003; Southall *et al.,* 2007; Weilgart, 2007; Archer *et al.,* 2010). Behavioral reactions can vary not only among individuals but also within an individual, depending on previous experience with a sound source, context, and numerous other factors (Ellison *et al.,* 2012), and can vary depending on characteristics associated with the sound source (*e.g.*, whether it is moving or stationary, number of sources, distance from the source). In general, pinnipeds seem more tolerant of, or at least habituate more quickly to, potentially disturbing underwater sound than do cetaceans, and generally seem to be less responsive to exposure to industrial sound than most cetaceans. Please see Appendices B-C of Southall *et al.,* (2007) for a review of studies involving marine mammal behavioral responses to sound.

Habituation can occur when an animal's response to a stimulus wanes with repeated exposure, usually in the absence of unpleasant associated events (Wartzok *et al.,* 2003). Animals are most likely to habituate to sounds that are predictable and unvarying. It is important to note that habituation is appropriately considered as a "progressive reduction in response to stimuli that are perceived as neither aversive nor beneficial," rather than as, more generally, moderation in response to human disturbance (Bejder *et al.,* 2009). The opposite process is sensitization, when an unpleasant experience leads to subsequent responses, often in the form of avoidance, at a lower level of exposure.

As noted above, behavioral state may affect the type of response. For example, animals that are resting may show greater behavioral change in response to disturbing sound levels than animals that are highly motivated to remain in an area for feeding

(Richardson *et al.,* 1995; NRC, 2003; Wartzok *et al.,* 2003). Controlled experiments with captive marine mammals have showed pronounced behavioral reactions, including avoidance of loud sound sources (Ridgway *et al.,* 1997; Finneran *et al.,* 2003). Observed responses of wild marine mammals to loud pulsed sound sources (typically seismic airguns or acoustic harassment devices) have been varied but often consist of avoidance behavior or other behavioral changes suggesting discomfort (Morton and Symonds 2002; see also Richardson *et al.,* 1995; Nowacek *et al.,* 2007).

Available studies show wide variation in marine mammal response to underwater sound; therefore, it is difficult to predict specifically how any given sound in a particular instance might affect marine mammals perceiving the signal. If a marine mammal does react briefly to an underwater sound by changing its behavior or moving a small distance, the impacts of the change are unlikely to be significant to the individual, l*et al*one the stock or population. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on individuals and populations could be significant (*e.g.*, Lusseau and Bejder, 2007; Weilgart, 2007; NRC, 2005). There are broad categories of potential response, which we describe in greater detail here, that include alteration of dive behavior, alteration of foraging behavior, effects to breathing, interference with or alteration of vocalization, avoidance, and flight.

Changes in dive behavior can vary widely and may consist of increased or decreased dive times and surface intervals as well as changes in the rates of ascent and descent during a dive (*e.g.*, Frankel and Clark, 2000; Costa *et al.,* 2003; Ng and Leung, 2003; Nowacek *et al.,* 2004; Goldbogen *et al.,* 2013a,b). Variations in dive behavior may reflect interruptions in biologically significant activities (*e.g.*, foraging) or they may be of little biological significance. The impact of an alteration to dive behavior resulting from an acoustic exposure depends on what the animal is doing at the time of the exposure and the type and magnitude of the response.

Disruption of feeding behavior can be difficult to correlate with anthropogenic sound exposure, so it is usually inferred by observed displacement from known foraging areas, the appearance of secondary indicators (*e.g.*, bubble nets or sediment plumes), or changes in dive behavior. As for other types of behavioral response, the frequency, duration, and temporal pattern of signal presentation, as well as differences in species sensitivity, are likely contributing factors to differences in response in any given circumstance (*e.g.*, Croll *et al.,* 2001; Nowacek *et al.,* 2004; Madsen *et al.,* 2006; Yazvenko *et al.,* 2007). A determination of whether foraging disruptions incur fitness consequences would require information on or estimates of the energetic requirements of the affected individuals and the relationship between prey availability, foraging effort and success, and the life history stage of the animal.

Respiratory variations with different behaviors and alterations to breathing rate as a function of acoustic exposure can be expected to co-occur with other behavioral reactions, such as a flight response or an alteration in diving. However, respiration rates in and of themselves may be representative of annoyance or an acute stress response. Various studies have shown that respiration rates may either be unaffected or could increase, depending on the species and signal characteristics, again highlighting the importance in understanding species differences in the tolerance of underwater noise when determining the potential for impacts resulting from anthropogenic sound exposure (*e.g.*, Kastelein *et al.,* 2001, 2005b, 2006; Gailey *et al.,* 2007).

Marine mammals vocalize for different purposes and across multiple modes, such as whistling, echolocation click production, calling, and singing. Changes in vocalization behavior in response to anthropogenic noise can occur for any of these modes and may result from a need to compete with an increase in background noise or may reflect increased vigilance or a startle response. For example, in the presence of potentially masking signals, humpback whales and killer whales have been observed to increase the length of their songs (Miller *et al.,* 2000; Fristrup *et al.,* 2003; Foote *et al.,* 2004), while North Atlantic right whales (*Eubalaena glacialis*) have been observed to shift the frequency content of their calls upward while reducing the rate of calling in areas of increased anthropogenic noise (Parks *et al.,* 2007). In some cases, animals may cease sound production during production of aversive signals (Bowles *et al.,* 1994).

Avoidance is the displacement of an individual from an area or migration path as a result of the presence of a sound or other stressors, and is one of the most obvious manifestations of disturbance in marine mammals (Richardson *et al.,* 1995). For example, gray whales are known to change direction – deflecting from customary migratory paths – in order to avoid noise from seismic surveys (Malme *et al.,* 1984). Avoidance may be short-term, with animals returning to the area once the noise has ceased (*e.g.*, Bowles *et al.,* 1994; Goold, 1996; Morton and Symonds, 2002; Gailey *et al.,* 2007). Longer-term displacement is possible, however, which may lead to changes in abundance or distribution patterns of the affected species in the affected region if habituation to the presence of the sound does not occur (*e.g.*, Blackwell *et al.,* 2004; Bejder *et al.,* 2006; Teilmann *et al.,* 2006).

A flight response is a dramatic change in normal movement to a directed and rapid movement away from the perceived location of a sound source. The flight response differs from other avoidance responses in the intensity of the response (*e.g.*, directed movement, rate of travel). Relatively little information on flight responses of marine mammals to anthropogenic signals exist, although observations of flight responses to the presence of predators have occurred (Connor and Heithaus, 1996). The result of a flight response could range from brief, temporary exertion and displacement from the area where the signal provokes flight to, in extreme cases, marine mammal strandings (Evans and England, 2001). However, it should be noted that response to a perceived predator does not necessarily invoke flight (Ford and Reeves, 2008), and whether individuals are solitary or in groups may influence the response.

Behavioral disturbance can also impact marine mammals in more subtle ways. Increased vigilance may result in costs related to diversion of focus and attention (*i.e.*, when a response consists of increased vigilance, it may come at the cost of decreased attention to other critical behaviors such as foraging or resting). These effects have generally not been demonstrated for marine mammals, but studies involving fish and terrestrial animals have shown that increased vigilance may substantially reduce feeding rates (*e.g.*, Beauchamp and Livoreil 1997; Fritz *et al,* 2002; Purser and Radford, 2011). In addition, chronic disturbance can cause population declines through reduction of fitness (*e.g.*, decline in body condition) and subsequent reduction in reproductive success, survival, or both (*e.g.*, Harrington and Veitch, 1992; Daan *et al.,* 1996; Bradshaw *et al.,* 1998). However, Ridgway *et al.,* (2006) reported that increased vigilance in bottlenose dolphins exposed to sound over a five-day period did not cause any sleep deprivation or stress effects.

Many animals perform vital functions, such as feeding, resting, traveling, and socializing, on a diel cycle (24-hour cycle). Disruption of functions resulting from reactions to stressors such as sound exposure are more likely to be significant if they last more than one diel cycle or recur on subsequent days (Southall *et al.,* 2007). Consequently, a behavioral response lasting less than one day and not recurring on subsequent days is not considered particularly severe unless it could directly affect reproduction or survival (Southall *et al.,* 2007). Note that there is a difference between multi-day substantive behavioral reactions and multi-day anthropogenic activities. For example, just because an activity lasts for multiple days does not necessarily mean that individual animals are either exposed to activity-related stressors for multiple days or, further, exposed in a manner resulting in sustained multi-day substantive behavioral responses.

Stress responses – An animal's perception of a threat may be sufficient to trigger stress responses consisting of some combination of behavioral responses, autonomic nervous system responses, neuroendocrine responses, or immune responses (*e.g.*, Seyle, 1950; Moberg, 2000). In many cases, an animal's first and sometimes most economical (in terms of energetic costs) response is behavioral avoidance of the potential stressor. Autonomic nervous system responses to stress typically involve changes in heart rate, blood pressure, and gastrointestinal activity. These responses have a relatively short duration and may or may not have a significant long-term effect on an animal's fitness.

Neuroendocrine stress responses often involve the hypothalamus-pituitary-adrenal system. Virtually all neuroendocrine functions that are affected by stress – including immune competence, reproduction, metabolism, and behavior – are regulated by pituitary hormones. Stress-induced changes in the secretion of pituitary hormones have been implicated in failed reproduction, altered metabolism, reduced immune competence, and behavioral disturbance (*e.g.*, Moberg, 1987; Blecha, 2000). Increases in the circulation of glucocorticoids are also equated with stress (Romano *et al.,* 2004).

The primary distinction between stress (which is adaptive and does not normally place an animal at risk) and "distress" is the cost of the response. During a stress response, an animal uses glycogen stores that can be quickly replenished once the stress is alleviated. In such circumstances, the cost of the stress response would not pose serious fitness consequences. However, when an animal does not have sufficient energy reserves to satisfy the energetic costs of a stress response, energy resources must be diverted from other functions. This state of distress will last until the animal replenishes its energetic reserves sufficient to restore normal function.

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses are well-studied through controlled experiments and for both laboratory and free-ranging animals (*e.g.*, Holberton *et al.,* 1996; Hood *et al.,* 1998; Jessop *et al.,* 2003; Krausman *et al.,* 2004; Lankford *et al.,* 2005). Stress responses due to exposure to anthropogenic sounds or other stressors and their effects on marine mammals have also been reviewed (Fair and Becker, 2000; Romano *et al.,* 2002b, Wright *et al.,* 2007) and, more rarely, studied in wild populations (*e.g.*, Romano *et al.,* 2002a). For example, Rolland *et al.* (2012) found that noise reduction from reduced ship traffic in the Bay of Fundy was associated with decreased stress in North Atlantic right whales. These and other studies lead to a reasonable expectation that some marine mammals will experience physiological stress responses upon exposure to acoustic stressors and that it is possible that some of these would be classified as "distress." In addition, any animal experiencing TTS would likely also experience stress responses (NRC, 2003).

Masking - Sound can disrupt behavior through masking, or interfering with, an animal's ability to detect, recognize, or discriminate between acoustic signals of interest (*e.g.,* those used for intraspecific communication and social interactions, prey detection, predator avoidance, navigation) (Richardson *et al.,* 1995). Masking occurs when the receipt of a sound is interfered with by another coincident sound at similar frequencies and at similar or higher intensity, and may occur whether the sound is natural (*e.g.,* snapping shrimp, wind, waves, precipitation) or anthropogenic (*e.g.,* pile driving, shipping, sonar, seismic exploration) in origin. The ability of a noise source to mask biologically important sounds depends on the characteristics of both the noise source and the signal of interest (*e.g.,* signal-to-noise ratio, temporal variability, direction), in relation to each other and to an animal's hearing abilities (*e.g.,* sensitivity, frequency range, critical ratios, frequency discrimination, directional discrimination, age or TTS hearing loss), and existing ambient noise and propagation conditions. Masking of natural sounds can result when human activities produce high levels of background sound at frequencies important to marine mammals. Conversely, if the background level of underwater sound is high (*e.g.,* on a day with strong wind and high waves), an anthropogenic sound source would not be detectable as far away as would be possible under quieter conditions and would itself be masked. Given the limited vessel traffic near the Project Area and intermittent nature of pile installation and removal operations, any masking effects on marine mammals would likely be negligible.

In-Water Construction Effects on Marine Mammal Habitat - NSF's construction activities could have localized, temporary impacts on marine mammal habitat by increasing in-water sound pressure levels and slightly decreasing water quality. Construction activities are of short duration and would likely have temporary impacts on marine mammal habitat through increases in underwater sound. Increased noise levels may affect acoustic habitat (see masking discussion above) and adversely affect marine mammal prey in the vicinity of the project area (see discussion below). During pile installation activities, elevated levels of underwater noise would ensonify Hero Inlet and nearby waters where both fish and mammals may occur and could affect foraging success. Additionally, marine mammals may avoid the area during construction, however, displacement due to noise is expected to be temporary and is not expected to result in long-term effects to the individuals or populations.

Pile driving activities may temporarily increase turbidity resulting from suspended sediments. Any increases would be temporary, localized, and minimal. In general, turbidity associated with pile installation is localized to about a 25-foot (7.6 m) radius around the pile (Everitt *et al.,* 1980). Cetaceans are not expected to be close enough to the project activity areas to experience effects of turbidity, and any small cetaceans and pinnipeds could avoid localized areas of turbidity. Therefore, the impact from increased turbidity levels is expected to be discountable to marine mammals. No turbidity impacts to Hero Inlet or nearby foraging habitats are anticipated.

Sound may affect marine mammals and their habitat through impacts on the abundance, behavior, or distribution of prey species (*e.g.,* crustaceans, cephalopods, fish, and zooplankton). Marine mammal prey varies by species, season, and location. Here, we describe studies regarding the effects of noise on known marine mammal prey.

Fish utilize the soundscape and components of sound in their environment to perform important functions such as foraging, predator avoidance, mating, and spawning (*e.g.,* Zelick and Mann, 1999; Fay, 2009). Depending on their hearing anatomy and peripheral sensory structures, which vary among species, fishes hear sounds using pressure and particle motion sensitivity capabilities and detect the motion of surrounding water (Fay *et al.,* 2008). The potential effects of noise on fishes depends on the overlapping frequency range, distance from the sound source, water depth of exposure, and species-specific hearing sensitivity, anatomy, and physiology. Key impacts to fishes may include behavioral responses, hearing damage, barotrauma (pressure-related injuries), and mortality.

Fish react to sounds that are especially strong and/or intermittent low-frequency sounds, and behavioral responses such as flight or avoidance are the most likely effects. Short duration, sharp sounds can cause overt or subtle changes in fish behavior and local distribution. The reaction of fish to noise depends on the physiological state of the fish, past exposures, motivation (*e.g.,* feeding, spawning, migration), and other environmental factors. Hastings and Popper (2005) identified several studies that suggest fish may relocate to avoid certain areas of sound energy. Additional studies have documented effects of pile driving on fish, although several are based on studies in support of large, multiyear bridge construction projects (*e.g.,* Scholik and Yan, 2001, 2002; Popper and Hastings, 2009). Several studies have demonstrated that impulse sounds might affect the distribution and behavior of some fishes, potentially impacting foraging opportunities or increasing energetic costs (*e.g.,* Fewtrell and McCauley, 2012; Pearson *et al.,* 1992; Skalski *et al.,* 1992; Santulli *et al.,* 1999; Paxton *et al.,* 2017). However, some studies have shown no or slight reaction to impulse sounds (*e.g.,* Pena *et al.,* 2013; Wardle *et al.,* 2001; Jorgenson and Gyselman, 2009; Cott *et al.,* 2012).

Sound pressure levels (SPLs) of sufficient strength have been known to cause injury to fish and fish mortality. However, in most fish species, hair cells in the ear continuously regenerate and loss of auditory function likely is restored when damaged cells are replaced with new cells. Halvorsen *et al.,* (2012a) showed that a TTS of 4-6 dB was recoverable within 24 hours for one species. Impacts would be most severe when the individual fish is close to the source and when the duration of exposure is long. Injury caused by barotrauma can range from slight to severe and can cause death, and is most likely for fish with swim bladders. Barotrauma injuries have been documented during controlled exposure to impact pile driving (Halvorsen *et al.,* 2012b; Casper *et al.,* 2013).

The most likely impact to fish from construction activities at the Project Area would be temporary behavioral avoidance of the area. The duration of fish avoidance of this area after pile driving stops is unknown, but a rapid return to normal recruitment, distribution and behavior is anticipated.

Airborne Acoustic Effects - Pinnipeds that occur near the project site could be exposed to airborne sounds associated with pile driving that have the potential to cause behavioral harassment, depending on their distance from pile driving activities. However, in-air noise generated during pile driving activities at the pier should attenuate in air to less than levels that exceed NMFS established Level B harassment thresholds, before reaching the opposite side of Hero Inlet where seals may be on shore. A 2016 Final Rule for construction of a Navy Pier (81 FR 52614; August 9, 2016) estimated the greatest possible distances to airborne noise during installation of a 24" steel pile (using a source level of 111 dB re 20 microPascals) as 168.3 m to the 90 dB threshold for harbor seals and 53.2 m for all other seals (using a 100dB threshold). A 2019 Final Rule published for construction of the Liberty Development in Alaska estimated airborne noise during impact pile driving as 81 dB re 20 microPascals at 100 m and 93 dB re 20 microPascals at 160 m (84 FR 70274; December 20, 2019). Therefore, based on the distance to Bonaparte Point, it is unlikely that animals hauled out across Hero Inlet will be exposed to levels above the NMFS Level B harassment threshold for disturbance.

In summary, given the relatively small areas being affected (*i.e*. Hero Inlet and highly truncated sound fields extending out to 18 km), construction activities associated with the proposed action are not likely to have a permanent, adverse effect on any fish habitat, or populations of fish species. Any behavioral avoidance by fish of the disturbed area would still leave significantly large areas of fish and marine mammal foraging habitat in the nearby vicinity. Thus, we conclude that impacts of the specified activity are not likely to have more than short-term adverse effects on any prey habitat or populations of prey species. Further, any impacts to marine mammal habitat are not expected to result in significant or long-term consequences for individual marine mammals, or to contribute to adverse impacts on their populations.

Estimated Take

This section provides an estimate of the number of incidental takes proposed for authorization through this IHA, which will inform both NMFS' consideration of "small numbers" and the negligible impact determination.

Harassment is the only type of take expected to result from these activities. Except with respect to certain activities not pertinent here, section 3(18) of the MMPA defines "harassment" as any act of pursuit, torment, or annoyance, which (i) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment).

Authorized takes would primarily be by Level B harassment, as use of the acoustic sources (*i.e.*, pile installation and removal equipment) has the potential to result in disruption of behavioral patterns for individual marine mammals. There is also some potential for auditory injury (Level A harassment) to result, primarily for mysticetes due to large PTS zones as well as for phocids and otariids due to haulouts in the vicinity of the Project Area. Auditory injury is unlikely to occur for high frequency or mid-frequency species. The proposed mitigation and monitoring measures are expected to minimize the severity of the taking to the extent practicable.

As described previously, no mortality or serious injury is anticipated or proposed to be authorized for this activity. Below we describe how the take is estimated.

Generally speaking, we estimate take by considering: (1) acoustic thresholds above which NMFS believes the best available science indicates marine mammals will be behaviorally harassed or incur some degree of permanent hearing impairment; (2) the area or volume of water that will be ensonified above these levels in a day; (3) the density or occurrence of marine mammals within these ensonified areas; and (4) and the number of days of activities. We note that while these factors can contribute to a basic calculation to provide an initial prediction of takes, additional information that can qualitatively inform take estimates is also sometimes available (*e.g.,* previous monitoring results or average group size). Below, we describe the factors considered here in more detail and present the proposed take estimate.

Acoustic Thresholds

NMFS recommends the use of acoustic thresholds that identify the received level of underwater sound above which exposed marine mammals would be reasonably expected to be behaviorally harassed (equated to Level B harassment) or to incur PTS of some degree (equated to Level A harassment).

Level B Harassment for non-explosive sources – Though significantly driven by received level, the onset of behavioral disturbance from anthropogenic noise exposure is also informed to varying degrees by other factors related to the source (*e.g.*, frequency, predictability, duty cycle), the environment (*e.g.*, bathymetry), and the receiving animals (hearing, motivation, experience, demography, behavioral context) and can be difficult to predict (Southall *et al.,* 2007, Ellison *et al.*, 2012). Based on what the available science indicates and the practical need to use a threshold based on a factor that is both predictable and measurable for most activities, NMFS uses a generalized acoustic threshold based on received level to estimate the onset of behavioral harassment. NMFS predicts that marine mammals are likely to be behaviorally harassed in a manner we consider Level B harassment when exposed to underwater anthropogenic noise above received levels of 120 dB re 1 μPa (rms) for continuous (*e.g.,* vibratory pile-driving, DTH) and above 160 dB re 1 μPa (rms) for non-explosive impulsive (*e.g.*, seismic airguns, impact pile driving) or intermittent (*e.g.*, scientific sonar) sources.

DTH pile installation includes drilling (non-impulsive sound) and hammering (impulsive sound) to penetrate rocky substrates (Denes *et al.,* 2016; Denes *et al.,* 2019; Reyff and Heyvaert 2019). DTH pile installation was initially thought be a primarily non-impulsive noise source. However, Denes *et al.,* (2019) concluded from a study conducted in Virginia, that DTH pile installation should also be characterized as impulsive based on Southall *et al.,* (2007), who stated that signals with a >3 dB difference in sound pressure level in a 0.035-second window compared to a 1-second window can be considered impulsive. Therefore, DTH pile installation is treated as both an impulsive and non-impulsive noise source. In order to evaluate Level A harassment, DTH pile installation activities are evaluated according to the impulsive criteria and using 160 dB rms. Level B harassment isopleths for DTH are determined by applying non-impulsive criteria and using the 120 dB rms threshold which is also used for vibratory driving. This approach ensures that the largest ranges to effect for both Level A and Level B harassment are accounted for in the take estimation process for DTH.

NSF's proposed activity includes the use of continuous (vibratory hammer, DTH pile installation, hydrogrinder) and impulsive (impact pile driving, DTH pile installation) sources, and therefore the 120 and 160 dB re 1 μPa (rms) is/are applicable.

Level A harassment for non-explosive sources - NMFS' Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0) (Technical Guidance, 2018) identifies dual criteria to assess auditory injury (Level A harassment) to five different marine mammal groups (based on hearing sensitivity) as a result of exposure to noise from two different types of sources (impulsive or non-impulsive). NSF's proposed activity includes the use of impulsive (*i.e.* impact hammer, DTH pile installation) and non-impulsive (*i.e.*, vibratory hammer, DTH pile installation, rock chipping, hydrogrinder) sources.

These thresholds are provided in the Table 6. The references, analysis, and methodology used in the development of the thresholds are described in NMFS 2018 Technical Guidance, which may be accessed at *https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance*.

Table 6. Thresholds Identifying the Onset of Permanent Threshold Shift

	PTS Onset Acoustic Thresholds* (Received Level)	
Hearing Group	Impulsive	Non-impulsive
Low-Frequency (LF) Cetaceans	*Cell 1* $L_{pk,flat}$: 219 dB $L_{E,LF,24h}$: 183 dB	*Cell 2* $L_{E,LF,24h}$: 199 dB
Mid-Frequency (MF) Cetaceans	*Cell 3* $L_{pk,flat}$: 230 dB $L_{E,MF,24h}$: 185 dB	*Cell 4* $L_{E,MF,24h}$: 198 dB

High-Frequency (HF) Cetaceans	*Cell 5* $L_{pk,flat}$: 202 dB $L_{E,HF,24h}$: 155 dB	*Cell 6* $L_{E,HF,24h}$: 173 dB
Phocid Pinnipeds (PW) (Underwater)	*Cell 7* $L_{pk,flat}$: 218 dB $L_{E,PW,24h}$: 185 dB	*Cell 8* $L_{E,PW,24h}$: 201 dB
Otariid Pinnipeds (OW) (Underwater)	*Cell 9* $L_{pk,flat}$: 232 dB $L_{E,OW,24h}$: 203 dB	*Cell 10* $L_{E,OW,24h}$: 219 dB
* Dual metric acoustic thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds should also be considered. Note: Peak sound pressure (L_{pk}) has a reference value of 1 μPa, and cumulative sound exposure level (L_E) has a reference value of 1μPa^{2}s. In this Table, thresholds are abbreviated to reflect American National Standards Institute standards (ANSI 2013). However, peak sound pressure is defined by ANSI as incorporating frequency weighting, which is not the intent for this Technical Guidance. Hence, the subscript "flat" is being included to indicate peak sound pressure should be flat weighted or unweighted within the generalized hearing range. The subscript associated with cumulative sound exposure level thresholds indicates the designated marine mammal auditory weighting function (LF, MF, and HF cetaceans, and PW and OW pinnipeds) and that the recommended accumulation period is 24 hours. The cumulative sound exposure level thresholds could be exceeded in a multitude of ways (*i.e.*, varying exposure levels and durations, duty cycle). When possible, it is valuable for action proponents to indicate the conditions under which these acoustic thresholds will be exceeded.		

Ensonified Area

Here, we describe operational and environmental parameters of the activity that will feed into identifying the area ensonified above the acoustic thresholds, which include source levels and transmission loss coefficient.

The sound field in the Project Area is the existing background noise plus additional construction noise from the proposed project. Marine mammals are expected to be affected via sound generated by the primary components of the project (*i.e.*, DTH pile installation, vibratory pile removal, limited impact for proofing purpose, rock chipping and use of hydrogrinders).

The estimated sound source levels (SSL) proposed by NSF and used in this assessment are described below and are shown in Table 7. Appendix A in the application discusses in detail the sound source levels for all planned equipment. Sound levels from pile installation used in NSF's application came from the Caltrans Compendium (2015) or are based on empirical data collected from other sites with similar conditions (*e.g.*, rock substrate where DTH driving would be used to install piles). NSF referenced two studies to arrive at SSLs for 24-in DTH pile installation. Noise studies from Kodiak ferry terminal (Denes *et al.,* 2016) and Skagway cruise ship terminal (Reyff and Heyvart, 2019; Reyff, 2020). Results are shown in Table 7. NMFS has developed DTH pile installation guidelines which contain recommendations for appropriate SSLs. NSF applied these recommendations for 36-in DTH pile installation. However, NSF proposed to use the DTH pile installation SSLs shown in Table 7, which for 24-in DTH pile installation and 24-in sockets which are more conservative than those recommended by NMFS, and NMFS deemed this approach acceptable.

NSF determined the SSLs for rock chipping based on underwater sounds measured for concrete demolition. NSF examined two sets of data available during the demolition of the Tappan Zee Bridge (state of New York) pier structures. NSF also considered the results from another study conducted by the Washington State Department of Transportation (WSDOT). Results from that analysis are shown in Table 7.

The U.S. Navy has assessed sound levels of the use of a hydrogrinder through underwater measurements (U.S. Navy 2018). The Navy measurements were reported in 1/1-octave frequency bands from 125 to 8,000 Hz for the helmet position that was assumed to be 0.5 to 1 meter from the hydraulic grinder operation. The overall unweighted sound level was computed to be 167.5 dB at 0.5 to 1 meter. Source sound levels in this report are provided for 10-m distances. Since this is a point source of sound, spherical spreading 20 Log TL coefficient results in a source sound level of 142 to 148 dB at 10 meters (see Appendix A in the application). A value of 146 dB at 10m has been used to estimate marine mammal take associated with these tools.

NSF assumed that installation of approximately one to two piles would occur over a 12-hour work day. To be precautionary in calculating isopleths, this application assumes two installation activities would occur simultaneously. For example, two 36-in piles installed simultaneously or one 36-in pile and one 24-in pile. Brief impact pile driving of about 10 strikes may be used to seat the piles. A likely approach to installing 36-in piles would be to use DTH to install two 36-in piles simultaneously; one 36-in pile would be installed to 20-ft socket depth while a second 36-in abutment pile would be installed to a 30-ft socket depth. The abutment piles require additional depth to support lateral loads and to provide side friction against ice uplift that could occur at the shoreline. It is also possible that both 36-in piles may be installed simultaneously to 20-ft socket.

Rock chipping may be required to level pile areas and would normally occur on the same day as DTH pile installation, if possible. If rock chipping is conducted separately from DTH pile installation, takes are accounted for by using the area ensonified during DTH pile installation to calculate takes. This precautionary approach overestimates takes that could occur if only rock chipping is conducted by itself. Rock chipping is considered to be an impulsive source.

Existing sheetpile would be removed through vibratory extraction. In some instances it may be necessary to remove piles by cutting them off at the mudline using underwater hand cutting tools. Such activity would occur on the same days as vibratory extraction. Cutting piles off at the mudline would result in less underwater noise than vibratory removal. To be precautionary, estimated marine mammal takes were calculated by assuming all piles were removed by vibratory extraction.

Table 7. Sound Source Levels

Measured Sound Levels[1]					Source
Activity	Peak	RMS	SEL[2]	TL	
24-in Piles					
DTH pile installation	190	166	154	15	Denes *et al.,* (2016)
Vibratory Driving[4]	170	165	165	15	Caltrans (2015)

Impact Driving	195	181	168	15	Caltrans (2015)
36-in Piles					
DTH pile installation	194	166	164	15	The DTH sound source proxy of 164 dB SEL is from 42-in piles, Reyff (2020) and Denes *et al.,* (2019)
Vibratory Driving	180	170	170	15	Caltrans (2015)
Impact Driving	210	193	183	15	Caltrans (2015)
H Piles inserted in 24-in. Sockets					
DTH pile installation	190	166	154	15	Denes *et al.,* (2016)
Vibratory Driving	170	165	165	15	Caltrans (2015)
Impact Driving	195	180	170	15	Caltrans (2015)
Removal of 24-in Template Piles					
Vibratory Driving	170	165	165	15	Caltrans (2015)
Removal of Sheet Piles					
Vibratory Driving	175	160	160	15	Caltrans (2015)
Rock Chipping					
Hydraulic Breaker	197	184	175	22	Tappan Zee Bridge[6,7]
Anode Installation					
Hydro-grinder		146		20	U.S. Navy (2008)

[1]See Appendix A in application for references and discussion of all sound sources.
[2]SEL is single strike for impact driving and DTH pile installation. SEL for vibratory installation is per second.
[4]Includes removal of 24-in. piles
[5]While it is possible the socket depth would be only 20 feet, this application assumes the greater depth to be precautionary.
[6]Reyff, J. 2018.Demolition of Existing Tappan Zee Bridge. Summary of Underwater Sound Measurements for Mechanical Demolition of Concrete Pile Caps at Piers 114 and 115, Circular Caisson at Pier 166, and Rectangular Caisson at Pier 170. To David Capobianco, New York State Thruway Authority. December 18, 2020.

[7]Reyff, J.2018. Demolition of Existing Tappan Zee Bridge Subject: Summary of Underwater Sound Measurements for Mechanical Demolition of Ice Breakers at Piers 173 and 169. To Kristine Edwards, New York State Thruway Authority. January 10, 2018.

When the sound fields from two or more concurrent pile installation activities overlap, the decibel addition of continuous noise sources results in much larger zone sizes than a single source. Decibel addition is not a consideration when sound fields do not overlap. The increased SLs potentially associated with two concurrent sources with overlapping sound fields are shown in Table 8 (WSDOT 2015). Decibel addition is only applicable to continuous sources. According to NMFS guidance the SL for continuous sounds from DTH pile installation is 166 dB regardless of the size of the pile. Under decibel addition, simultaneous DTH pile installation activities would use a SL of 169 (166 + 3) to derive the isopleth for the Level B harassment zone.

Table 8. Simultaneous Source Decibel Addition

Hammer Types	Difference in SSL	Level A Zones	Level B Zones
Vibratory, Impact	Any	Use impact zones	Use largest zone
Impact, Impact	Any	Use zones for each pile size and number of strikes	Use zone for each pile size
Vibratory, Vibratory	0 or 1 dB	Add 3 dB to the higher source level	Add 3 dB to the higher source level
	2 or 3 dB	Add 2 dB to the higher source level	Add 2 dB to the higher source level
	4 to 9 dB	Add 1 dB to the higher source level	Add 1 dB to the higher source level
	10 dB or more	Add 0 dB to the higher source level	Add 0 dB to the higher source level

Level B Harassment Zones

Transmission loss (TL) is the decrease in acoustic intensity as an acoustic pressure wave propagates out from a source. TL parameters vary with frequency, temperature, sea conditions, current, source and receiver depth, water depth, water chemistry, and bottom composition and topography. The general formula for underwater TL is:

TL = B * Log10 (R1/R2), where

TL = transmission loss in dB

B = transmission loss coefficient; for practical spreading equals 15

R1 = the distance of the modeled SPL from the driven pile, and

R2 = the distance from the driven pile of the initial measurement

The recommended TL coefficient for most nearshore environments is the practical spreading value of 15. This value results in an expected propagation environment that would lie between spherical and cylindrical spreading loss conditions, which is the most appropriate assumption for NSF's proposed activity in the absence of specific modelling. Level B harassment isopleths are shown in Table 15 and Table 16.

Level A Harassment Zones

When the NMFS Technical Guidance (2016) was published, in recognition of the fact that ensonified area/volume could be more technically challenging to predict because of the duration component in the new thresholds, we developed a User Spreadsheet that includes tools to help predict a simple isopleth that can be used in conjunction with marine mammal density or occurrence to help predict takes. We note that because of some of the assumptions included in the methods used for these tools, we anticipate that isopleths produced are typically going to be overestimates of some degree, which may result in some degree of overestimate of Level A harassment take. However, these tools offer the best way to predict appropriate isopleths when more sophisticated 3D modeling methods are not available, and NMFS continues to develop ways to quantitatively refine these tools, and will qualitatively address the output where appropriate. For stationary sources such as those planned for this project, NMFS User Spreadsheet predicts the distance at which, if a marine mammal remained at that distance the whole duration of the activity, it would incur PTS. Inputs used in the User Spreadsheet, and the resulting isopleths are reported below. Tables 9, 10 and 11 shows User inputs for single sound sources while Tables 12, 13, and 14 contain User inputs for simultaneous sources. The resulting Level A harassment isopleths for non-simultaneous activities and simultaneous activities are shown in Table 15 and Table 16 respectively. Level B harassment isopleths for simultaneous DTH pile installation utilize a 169 dB SL and corresponding isopleths are shown in Table 16. Note that strike numbers for DTH pile installation were derived by applying the duration required to drive a single pile (minutes), the number of piles driven per day, and the strike rate (average strikes per second) rates to arrive at the total number of strikes in a 24-hour period. A rate of 10 strikes per second was assumed.

Table 9. NMFS Technical Guidance (2020) User Spreadsheet Inputs To Calculate PTS Isopleths for Non-Simultaneous Vibratory Pile Installation Activities and Hydrogrinding

	36-in (Dock Dock Abutment)-in	RHIB Fender Piles 24-in	24-in template 10'socket)	24-in wave attenuator piles-in	24-in Template pile removal	Sheet Pile Removal	Anode installation (hydro-grinding)
Spreadsheet Tab Used	A.1) Non-Impul, Stat, Cont.	A.1) Non-Impul, Stat, Cont.	A.1) Non-Impul, Stat, Cont.	A.1) Non-Impul, Stat, Cont.	A.1) Non-Impul, Stat, Cont.	A.1) Non-Impul, Stat, Cont.	A.1) Non-Impul, Stat, Cont.
Source Level (SPL RMS)	170	165	165	165	165	160	146
15Transmission Loss Coefficient	15	15	15	15	15	15	20
Weighting Factor Adjustment (kHz)	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Time to install / remove single pile (minutes)	30	30	30	30	30	30	120
Piles to install / remove per day	1	1	2	1	16	16	1

Table 10. NMFS Technical Guidance (2020) User Spreadsheet Input To Calculate PTS Isopleths for Non-Simultaneous Impact Pile Installation Activities

	36-in (Dock, Dock Abutment)	24-in RHIB, (template, wave attenuator)	Rock Chipping
Spreadsheet Tab Used	E.1) Impact pile driving	E.1) Impact pile driving	E) Stationary Source: Impulsive, Intermittent
Source Level (Single Strike/shot SEL)	183	168	197
Transmission Loss Coefficient	15	15	22
Weighting Factor Adjustment (kHz)	2	2	0
Number of pulses in 1-hr period	10	10	2,700
Piles per day	1	1	

Table 11. NMFS Technical Guidance (2020) User Spreadsheet Input To Calculate PTS Isopleths for Non-Simultaneous DTH Pile Installation Activities

	36-in Dock 20' socket	Dock Abutment-36-in 30' socket	24-in RHIB, template, wave attenuator

Spreadsheet Tab Used	E.2) DTH Pile Driving	E.2) DTH Pile Driving	E.2) DTH Pile Driving
Source Level (Single Strike/Shot SEL)	164	164	154
Transmission Loss Coefficient	15	15	15
Strike rate (Strikes/sec)	10	10	10
Duration (min)	345	518	345
Weighting Factor Adjustment (kHz)	2	2	2
SStrikes/pile	207000	310500	207000
Piles to install / remove per day	1	1	1

Table 12. NMFS Technical Guidance (2020) User Spreadsheet Input To Calculate PTS Isopleths for Simultaneous Vibratory Pile Installation Activities

	36-in Dock 20' socket x 2 Dock Abutment	RHIB Fender Piles 24-in x 2	24-in template 10'socket x 4	24-in wave attenuator piles-10'socket x 2	24-in wave attenuator piles-20'socket x 2
Spreadsheet Tab Used	A.1) Non-Impul, Stat, Cont.	A.1) Non-Impul, Stat, Cont.	A.1) Non-Impul, Stat, Cont.	A.1) Non-Impul, Stat, Cont.	A.1) Non-Impul, Stat, Cont.
Source Level (SPL RMS)	173	168	168	168	168
Transmission Loss Coefficient	15	15	15	15	15
Weighting Factor Adjustment (kHz)	2.5	2.5	2.5	2.5	2.5
Time to install / remove single pile (minutes)	30	30	15	30	30
Piles to install / remove per day	2	2	4	2	2

Table 13. NMFS Technical Guidance (2020) User Spreadsheet Input To Calculate PTS Isopleths for Simultaneous Impact Pile Installation Activities

	36-in (Dock 20' socket x 2) or Dock Abutment-36-in	RHIB Fender	24-in template	24-in wave attenuator piles x 2

	30’ and 20’ socket	Piles 24-in x 2	10’socket x 4	
Spreadsheet Tab Used	E.1) Impact pile driving	E.1) Impact pile driving	E.1) Impact pile driving	E.1) Impact pile driving
Source Level (Single Strike/shot SEL)	183	168	168	168
Transmission Loss Coefficient	15	15	15	15
Weighting Factor Adjustment (kHz)	2	2	2	2
Strikes/pile	10	10	10	10
Piles per day	2	2	4	2

Table 14. NMFS Technical Guidance (2020) User Spreadsheet Input To Calculate PTS Isopleths for Simultaneous DTH Pile Installation Activities

	36-in Dock 20’ socket x 2	Dock Abutment-36-in 30’ and 20’ socket	24-in template 10’socket x 4	24-in wave attenuator piles-10’socket x 2/ RHIB Fender Piles 24-in x 2
Spreadsheet Tab Used	E.2) DTH Pile Driving	E.2) DTH Pile Driving	E.2) DTH Pile Driving	E.2) DTH Pile Driving
Source Level (Single Strike/Shot SEL)	164	164	154	154
Transmission Loss Coefficient	15	15	15	15
Strike rate (Strikes/sec)	10	10	10	10
Duration (min)	345	430	172.5	345
Weighting Factor Adjustment (kHz)	2	2	2	2
Strikes/pile	414,000	517,500	103500	207000
Piles to install per day	2	2	4	2

Table 15. Level A and Level B Harassment Isopleths for Non-Simultaneous Pile Installation Activities

		Level A Harassment Zones (m) Based on SELcum					Level B Harassment Zone (m)
		Cetaceans			Pinnipeds		
		LF	MF	HF	PW	OW	
Dock, 36-in Dia. Pile Installation, 20’ Socket Depth - 1 pile/day	DTH Pile Drilling	1,891	67	2,253	1,012	74	11,659
Dock Abutment, 36-in Dia. Pile Installation, 30’ Socket Depth - 1 pile/day	DTH Pile Drilling	2,478	88	2,951	1,326	97	11,659
RHIB Fender Piles, 24-in Dia. Pile Installation, 20’ Socket - 1 pile/day	DTH Pile Drilling	407	15	485	218	16	11,659
24-in Dia. Template Piles, 10’ Socket Depth - 2 piles/day	DTH Pile Drilling	407	15	485	218	16	11,659
24-in Dia Wave Attenuator Piles, 20’ Socket Depth - 1 pile/day	DTH Pile Drilling	407	15	485	218	16	11,659
Retaining Wall HP Pile inserted in Drilled 24-in Dia Sockets, 20’ Socket Depth - 1 pile/day	DTH Pile Drilling	407	15	485	218	16	11,659m
Removal of 24-in Dia. Template Piles - 16 piles	Vibratory	51	5	75	31	2	10,000
Removal of Sheet Piles	Vibratory	23	2	35	14	1	4,642
Rock Chipping/Floor Preparation	Hydraulic Breaker	403	50	716	204	29	123
Anode Installation	Hydrogrinder	1.9	0.3	2.5	1.3	0.2	200

Table 16. Level A and Level B Harassment Isopleths for Simultaneous Pile Installation Activities

Daily Activity Scenario	Installation Method	Level A Harassment Zones (m) Based on SELcum					Level B Harassment Zone (m)
		Cetaceans			Pinnipeds		
		LF	MF	HF	PW	OW	
Dock, 36-in Dia. Pile Installation, 20’ Socket Depth - 2 pile/day	DTH Pile Installation	3,002	107	3,576	1,607	117	18,478
Dock Abutment, 36-in Dia. Pile Installation, 30’ Socket Depth and 36-in Dia. Pile 20’ Socket Depth		3,484	124	4,149	1,864	136	18,478
RHIB Fender Piles, 24-in Dia. Pile Installation, 20’ Socket - 2 pile/day		647	23	770	346	25	18,478
24-in Dia. Template Piles, 10’ Socket Depth - 4 piles/day							
24-in Dia Wave Attenuator Piles, 20’ Socket Depth - 2 pile/day							
Retaining Wall - HP Pile inserted in Drilled 24-in Dia Sockets, 20’ Socket Depth - 2 piles/day							
Dock, 36-in Dia. Pile Installation, 20’ Socket Depth - 1 pile/day and Wave Attenuator, 24-in Dia. Pile Installation, 20’ Socket - 1 pile/day		2,011	72	2,395	1,076	78	18,478
Dock 36-in Dia. Pile Installation 30’ Socket Depth and 24-in Dia Pile Installation 20’ Socket Depth		2,885	103	3,436	1,544	133	18,478
36-in Dock 20’ socket x 2 Dock Abutment	Vibratory Installation	43	4	64	26	2	34,146
RHIB Fender Piles 24-in x 2		20	2	30	12	1	15,849
24-in template 10’socket x 4							

<table>
<tr><td>24-in wave attenuator piles-
10’socket x 2</td><td rowspan="2"></td><td rowspan="2">31.8</td><td rowspan="2">3</td><td rowspan="2">47</td><td rowspan="2">19</td><td rowspan="2">1.4</td><td rowspan="2"></td></tr>
<tr><td>24-in wave attenuator piles-
20’socket x 2</td></tr>
</table>

The calculated area that would be ensonified by single or multiple pile installation and removal sound sources is calculated based on the distance from the Palmer Station Pier installation location to the edge of the isopleth for Level B harassment and for each hearing group for Level A harassment. The scenario with the largest zone is used to estimate potential marine mammal exposures and those areas are shown in Table 17. The Palmer Station Pier is located in a narrow portion of Hero Inlet and the areas potentially ensonified above Level A and Level B harassment thresholds is truncated by the location of land masses including assorted islands (*i.e.*, shadow effect).

Table 16 shows the construction scenario (installation of two 36-in piles, one at 30- ft and a second at 20-ft socket depth) that results in the largest PTS zone isopleths while Table 17 shows the areas of the corresponding zones ensonified areas. The maximum Level A harassment distance would be 1,864 m (1.4 km^2) for phocids in water (PW), 3,484m (3.38 km^2) for LF cetaceans, and 4,149m (4.4 km^2) for HF cetaceans (although HF cetaceans are considered rare in the Project Area and Level A harassment takes are not proposed). The largest Level B harassment isopleth is associated with simultaneous DTH pile installation and would be at a distance of 18,478 m from the source covering an area of 54.99 m.

Table 17. Harassment Zone Areas Used for Take Estimation[1]

Pile Type	TotalPiles	Level A Max Area Cetaceans[3](km^2)	Level A Max Area Pinnipeds[3](km^2)	Level BArea All Species(km^2)
36-in piles (one @30-ft socket depth and one @20-ft socket depth)	18	3.38 (LF) 4.4 (HF) 0.03 (MF)	1.4 (PW) 0.03 (OW)	54.99
32-in piles (Bent 1)	4			
Pile Removal (24-in)	16	0.006 (LF) 0.012 (MF) ~0 (MF)	0.002 (PW)	20.78
Sheetpile Removal	20	0.001 (LF) 0.003 (HF) ~0 (MF)	0.0006(PW)	5.27
Anode Installation	n/a	n/a	n/a	0.07
Rock Chipping	unk			
Total	**88**			

[1]Assumes simultaneous installation (*i.e.*, two pile installations occurring at the same time).

Marine Mammal Occurrence and Take Estimation

In this section we provide the information about the presence, density, or group dynamics of marine mammals that will inform the take calculations.

The approach by which the information provided above is brought together to produce a quantitative take estimate is described here. For some species only observational data is available and is used to estimate take. For marine mammals with known density information estimated harassment take numbers are calculated using the following equation (summed across each type of activity):

Estimated take = animal density × ensonified area × operating days

As noted above we used the most conservative option for estimating ensonified area for each activity. We also used conservative estimates of the number of days of work for each activity.

Takes were estimated by considering the density of marine mammals per km^2 multiplied by the potential area ensonified (km^2) and the number of days the noise could occur during in-water construction. The Project Area is located in the nearshore environment relative to the Antarctic Peninsula as defined by data reported in Santora *et al. (*2009). Sources for density data and average group sizes are found in Table 6-3 in the application. For some species only offshore data were available, for some only nearshore data, and for others data existed for both areas. Offshore densities were used to estimate take for eight species. Nearshore densities were unavailable for three species. Nearshore densities were used to calculate take for four species. Data from these offshore sources results in averaging across large portions of the region. NSF notes that these data are from areas where cetaceans may occur in significantly greater densities than the Palmer Pier Project Area due to expected increased faunal density along the sea ice edge and shelf-frontal features in the southern oceans. These oceanographic features are not present within the Project Area, so lower densities of cetaceans are expected within close proximity to Palmer Station. Therefore, the offshore densities may represent an overestimate of anticipated densities within the Palmer Station Project Area.

NSF estimated Level A harassment takes by multiplying the Level A harassment areas by the species density (nearshore or offshore as described above) which was then multiplied by the expected number of pile driving days for each activity type. The exposures for each activity were added to arrive at calculated Level A harassment take number as shown in Table 20. In cases where both nearshore and offshore densities were available, the higher of the two densities is used to estimate take. Note that designated shutdown zones cover all of the Level A harassment zones with the exception of pinnipeds, where the zones in some cases are larger than the proposed 50-m shutdown zone. However, we are proposing to authorize take for some cetacean species where the calculated Level A harassment take is significant, and the large PTS zone sizes could allow animals to enter into these zones without being observed by protected species observers (PSOs).

A similar approach was employed to derive estimated take by Level B harassment. The Level B harassment zones are determined by taking the total area of the Level B harassment zones (54.99 km^2; 20.78 km^2; 5.27 km^2; 0.07 km^2) and subtracting the Level A harassment areas as defined by activity type and hearing group.

The Level B harassment zone area was multiplied by the highest density for a species (nearshore or offshore as described above) which was multiplied by the expected number of pile driving days for each activity type. The exposures for each activity were summed to arrive at the calculated Level B harassment take numbers as shown in Table 18. Additional detailed information may be found in Appendix B of the application.

Table 18. Calculated Level A and Level B Harassment Exposures

Species	Level A Harassment Total Exposures	Level B Harassment Total Exposures
Antarctic Minke Whale (LF)	15.23	312.25

Arnoux's Beaked Whale (MF)	0.0001	0.14
Blue Whale (LF)	0.0081	0.17
Fin Whale (LF)	13.74	281.70
Hourglass Dolphin (HF)	0.32	4.94
Humpback Whale (LF)	5.91	121.21
Killer Whale (MF)	0.04	111.70
Long-finned Pilot Whale (MF)	0.01	28.19
Southern Bottlenose Whale (MF)	0.009	23.55
Sei Whale (LF)	0.04	0.84
Southern Right Whale (LF)	0.07	1.34
Sperm Whale (MF)	0.02	16.73
Antarctic Fur Seal (OW)	0.15	356.50
Crabeater Seal (PW)	119.07	6128.78
Southern Elephant Seal (PW)	0.02	1.04
Leopard Seal (PW)	0.02	1.04
Weddell Seal (PW)	3.65	187.97

In addition to considering density data presented in the literature, recent marine mammal observation data from Hero Inlet and nearby areas between January 21, 2019 and March 31, 2020 are also considered in the take estimates. Observations within Hero Inlet near Palmer Station included animals observed in the waters of Hero Inlet, or hauled out at Gamage Point or Bonaparte Point. Gamage Point is approximately 100 m west of the pier area on Anvil Island while Bonaparte Point is located across Hero Inlet 135m southeast of the Pier area. Table 19 shows a comparison between observational data from the Project Area (NSF, personal communication) and the calculated takes by Level A harassment based on density data.

Table 19. Comparison of Observation Data from Hero Inlet, Gamage Point and Bonaparte Point 2019 – 2020 to Total Level A Harassment Exposure Estimates Calculated Based On Density Data

Species	January 21 – March 28, 2019 Observations	October 12, 2019 – March 31, 2020 Observations	Density-Based Total Exposures
Humpback Whale (LF)	0	0	5.91
Antarctic Fur Seal (OW)	73	70	0.15
Crabeater Seal (PW)	20	24	119.07
Southern Elephant Seal (PW)	1	0	0.02
Leopard Seal (PW)	3	2	0.02
Weddell Seal (PW)	8	6	3.65

Comparing the estimated exposures based on pinniped densities, number of days, and the Level A Harassment zone to local observational data from Palmer Station over two multiple-month periods suggests that some pinniped species were potentially observed at a greater rate than would be expected from density information. In the interest of generating a more conservative estimate that will ensure coverage for any marine mammals encountered, the number of Antarctic fur, leopard and Weddell seal takes have been increased to reflect the number individuals observed in Hero Inlet.

Table 20 compares the number of calculated and proposed Level A and B harassment takes for each species. Level B harassment takes for Arnoux's beaked whale, blue whale, hourglass dolphin, sei whale, and Southern right whale have been adjusted based on group size such that a higher level of Level B harassment take is proposed than was projected solely based on densities. Arnoux's beaked whales often occur in groups of 6-10 and occasionally up to 50 or more (Balcomb 1989). As a precautionary measure NSF requested and NMFS has proposed authorizing 12 takes of this species by Level B harassment. Classified as HF cetaceans, these beaked whales have a relatively large Level A harassment zone that extends to as much as 4,149 m. However, calculated take by Level A harassment is fractional and furthermore, this is a deep diving and deep foraging species and it would be unlikely that animals would congregate in a Level A harassment zone long enough to accrue enough energy to experience PTS. Therefore, no Level A take was requested by NSF nor is proposed for authorization by NMFS. Blue whales are unlikely to be found in the Project Area. However, NSF requested and NMFS conservatively proposes to authorize two Level B harassment takes based on one average group size (NMFS, 2020). Hourglass Dolphins group size is generally 2-6 individuals with groups of up to 25 observed (Santora 2012). Classified as HF cetaceans, these dolphins have a relatively large Level A harassment zone that extends to 4,149 m. However, local observational data sets have not recorded a single animal and the species tends to be found in waters close to the Antarctic Convergence. Given this information NMFS proposes to authorize 25 takes by Level B harassment which is a reduction from 60 takes requested by NSF. Level A harassment takes are not expected or authorized since the dolphin species is highly mobile and is unlikely to remain in the zone long enough to experience PTS. Sei whales have an average group size of 6 (NMFS 2020) and generally inhabit continental shelf and slope waters far from coastlines. They are unlikely to occur but as a precautionary measure NSF has requested and NMFS proposes to authorize 6 takes by Level B harassment. Takes by Level A harassment are not expected or proposed for authorization. Southern right whales live in groups of up to 20 individuals, but are more commonly found in groups of two or three, unless at feeding grounds. Observational surveys near Palmer Station did not record the presence of these whales. Therefore, NSF requested and NMFS conservatively proposes to authorize 20 takes of Southern right whale by Level B harassment. No take by Level A harassment is anticipated or proposed for authorization.

As discussed above, the proposed takes have been adjusted from the calculated takes based on observation data as summarized in Table 19. Local observers recorded 73 and 70 Antarctic fur seals in 2019 and 2020 respectively located in close proximity to the pier during months when construction would take place. As a precaution, the number of takes by Level A harassment requested by NSF and proposed for authorization by NMFS has been increased beyond the calculated density value to 80. Similarly, three leopard seals were observed in 2019 and two were recorded in 2020. To be precautionary, NSF requested and NMFS is proposing to authorize 5 leopard seal takes by Level B. Further, since leopard seals are thought to be more likely to spend more time in the immediate vicinity (*i.e.*, not as likely to travel through as the cetacean species discussed above) and potentially enough time in the Level A harassment zone to incur PTS, NMFS is also proposing to authorize 5 takes by Level A harassment. Finally, eight and six Weddell seals were observed in 2019 and 2020, respectively. Given this information, and again to be precautionary NSF has requested and NMFS is proposing to authorize 10 takes by Level A harassment. Finally, NMFS has proposed a single take by Level A harassment of Southern elephant seal. Like all seals authorized for take there are driving scenarios where the PTS isopleth would be larger than 50-m pinniped shutdown zone. While only one elephant seal has been observed near Palmer Station, it could occur in the Level A harassment zone.

Table 20. Proposed Takes by Level A and Level B Harassment Compared to Calculated Exposures

Species	Calculated Level A Harassment Exposures	Proposed Level A Harassment Take	Calculated Level B Harassment Exposures	Proposed Level B Harassment Take	Takes as Percent of Abundance
Antarctic Minke Whale (LF)	15.23	15	312.25	312	1.80
Arnoux's Beaked Whale (MF)[a]	0.00	0	0.14	12	Unknown
Blue Whale (LF)[a]	0.01	0	0.17	2	0.12
Fin Whale (LF)	13.74	14	281.70	282	6.33
Hourglass Dolphin (HF)[a]	0.32	0	4.94	25	0.01
Humpback Whale (LF)	5.91	6	121.21	121	1.34
Killer Whale (MF)	0.04	0	111.7	112	0.45
Long-finned Pilot Whale (MF)	0.01	0	28.19	28	0.01
Southern Bottlenose Whale (MF)	0.01	0	23.55	24	0.04
Sei Whale (LF)[a]	0.04	0	0.84	6	0.96
Southern Right Whale (LF)[a]	0.07	0	1.34	20	1.13

Sperm Whale (MF)	0.02	0	16.73	17	0.14
Antarctic Fur Seal (OW)	0.15	80[b]	356.5	357	0.02
Crabeater Seal (PW)	119.07	120	6,128.78	6,129	0.12
Southern Elephant Seal (PW)	0.02	1	1.04	1	<0.01
Leopard Seal (PW)	0.02	5[b]	1.04	1	<0.01
Weddell Seal (PW)	3.65	10[b]	187.97	188	0.04

[a] Level B harassment takes increased to account for group size assuming one group is encountered during the project
[b]Increased from calculated exposures due to local observational data.

Table 20 also shows the proposed take by harassment for all species as a percentage of stock abundance.

Proposed Mitigation

In order to issue an IHA under section 101(a)(5)(D) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to the activity, and other means of effecting the least practicable impact on the species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of the species or stock for taking for certain subsistence uses (latter not applicable for this action). NMFS regulations require applicants for incidental take authorizations to include information about the availability and feasibility (economic and technological) of equipment, methods, and manner of conducting the activity or other means of effecting the least practicable adverse impact upon the affected species or stocks and their habitat (50 CFR 216.104(a)(11)).

In evaluating how mitigation may or may not be appropriate to ensure the least practicable adverse impact on species or stocks and their habitat, as well as subsistence uses where applicable, we carefully consider two primary factors:

(1) The manner in which, and the degree to which, the successful implementation of the measure(s) is expected to reduce impacts to marine mammals, marine mammal

species or stocks, and their habitat. This considers the nature of the potential adverse impact being mitigated (likelihood, scope, range). It further considers the likelihood that the measure will be effective if implemented (probability of accomplishing the mitigating result if implemented as planned), the likelihood of effective implementation (probability implemented as planned); and

(2) The practicability of the measures for applicant implementation, which may consider such things as cost, impact on operations, and, in the case of a military readiness activity, personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity.

The following mitigation measures are proposed in the IHA:

- NSF must avoid direct physical interaction with marine mammals during construction activities. If a marine mammal comes within 10 m of such activity, operations must cease and vessels must reduce speed to the minimum level required to maintain steerage and safe working conditions;
- Training would occur between construction supervisors and crews and the PSO team and relevant NSF staff prior to the start of all pile driving and construction activities, and when new personnel join the work, in order to explain responsibilities, communication procedures, marine mammal monitoring protocol, and operational procedures are clearly understood;
- Pile driving activities must be halted upon observation of either a species for which incidental take is not authorized or a species for which incidental take has been authorized but the authorized number of takes has been met, entering or within the harassment zone;
- NSF will establish and implement a shutdown zone of 50 m for fur seals under all pile driving scenarios. The purpose of a shutdown zone is generally to define an area within which shutdown of the activity would occur upon sighting of a marine

mammal (or in anticipation of an animal entering the defined area). Shutdown zones typically vary based on the activity type and marine mammal hearing group. Shutdown zones for cetaceans and other pinnipeds are based on Level A harassment isopleths shown in Table 17. Based on observation data, fur seals are known to swim up Hero Inlet (approximately 135 m wide) to haul out. The proposed 50-m shutdown zone for fur seals can safely be observed, would prevent injury to seals while still allowing seals to move up the inlet where they may haul out on land, and would allow construction to continue safely and efficiently;

- Shutdown zones have been established for all hearing groups under all driving scenarios as shown in Tables 21 and 22 and are based on calculated Level A harassment zones;

- Monitoring must take place from 30 minutes prior to initiation of pile driving activity through 30 minutes post-completion of pile driving activity. Pre-start clearance monitoring must be conducted during periods of visibility sufficient for the lead PSO to determine the shutdown zones clear of marine mammals. Pile driving may commence following 30 minutes of observation when the determination is made;

- If the Level A harassment shutdown zones are not visible due to poor environmental conditions (*e.g.,* excessive wind or fog, high Beaufort state), pile installation would cease until the entirety of the Level A harassment shutdown zones is observable;

- If pile driving is delayed or halted due to the presence of a marine mammal, the activity may not commence or resume until either the animal has voluntarily exited and been visually confirmed beyond the shutdown zone or 15 minutes have passed without re-detection of the animal;

- If impact driving should be needed (*i.e.*, for proofing) NSF must use soft start techniques when impact pile driving. Soft start requires contractors to provide an initial set of three strikes at reduced energy, followed by a 30-second waiting period, then two subsequent reduced-energy strike sets. A soft start must be implemented at the start of each day that begins with impact pile driving and at any time impact driving would occur after cessation of impact pile driving for a period of 30 minutes or longer;

- In-water construction would occur during daylight over a 12-hour workday to minimize the potential for PTS for species that may occur within the Level A harassment zones; and

- When transiting to the site, marine mammal watches must be conducted by crew or those navigating the vessel. When in the Project Area, if a whale is sighted in the path of a support vessel or within 92 m (300 feet) from the vessel, NSF must reduce speed and must not engage the engines until the animals are clear of the area. If a whale is sighted farther than 92 m (300 feet) from the vessel, NSF must maintain a distance of 92 m (300 feet) or greater between the whale and the vessel and reduce speed to 10 knots or less. Vessels must not be operated in such a way as to separate members of a group of whales from other members of the group. A group is defined as being three or more whales observed within a 500 m area and displaying behaviors of directed or coordinated activity (*e.g.*, group feeding).

Table 21. Shutdown and Harassment Zones (meters) for Non-Simultaneous Pile Installation Activities

<table>
<tr><th rowspan="3">Pile size, type, and method</th><th colspan="5">Minimum Shutdown Zone</th><th rowspan="2">Level B Harassment Zone (m)</th></tr>
<tr><th colspan="3">Cetaceans</th><th colspan="2">Pinnipeds</th></tr>
<tr><th>LF</th><th>MF</th><th>HF</th><th>PW</th><th>OW</th><th></th></tr>
<tr><td>Dock, 36-in Dia. Pile Installation, 20’ Socket Depth - 1 pile/day (DTH)</td><td>1,900</td><td>70</td><td>2,255</td><td>1,015</td><td rowspan="3">50</td><td rowspan="3">11,659</td></tr>
<tr><td>Dock Abutment, 36-in Dia. Pile Installation, 30’ Socket Depth - 1 pile/day (DTH)</td><td>2500</td><td>90</td><td>2,955</td><td>1,330</td></tr>
<tr><td>RHIB Fender Piles, 24-in Dia. Pile Installation, 20’ Socket - 1 pile/day</td><td>410</td><td>15</td><td>485</td><td>220</td></tr>
</table>

24-in Dia. Template Piles, 10’ Socket Depth - 2 piles/day						
24-in Dia Wave Attenuator Piles, 20’ Socket Depth - 1 pile/day						
Retaining Wall HP Pile inserted in Drilled 24-in Dia Sockets, 20’ Socket Depth - 1 pile/day						
Removal of 24-in Dia. Template Piles - 16 piles	55	10	75	35		10,000
Removal of Sheet Piles	25		35	15		4,642
Rock Chipping/Floor Preparation	405	50	720	205		123
Anode Installation	10	10	10	10		200

Table 22. Shutdown and Harassment Zones (meters) for Simultaneous Pile Installation Activities

Daily Activity Scenario	Minimum Shutdown Zone					Level B Harassment Zone (m)
	Cetaceans			Pinnipeds		
	LF	MF	HF	PW	OW	
Dock, 36-in Dia. Pile Installation, 20’ Socket Depth - 2 pile/day	3,500	110	3,580	1,610	50	18,478
Dock Abutment, 36-in Dia. Pile Installation, 30’ Socket Depth and 36-in Dia. Pile 20’ Socket Depth		125	4,150	1,865		
RHIB Fender Piles, 24-in Dia. Pile Installation, 20’ Socket - 2 pile/day	650	25	770	350		
24-in Dia. Template Piles, 10’ Socket Depth - 4 piles/day						
24-in Dia Wave Attenuator Piles, 20’ Socket Depth - 2 pile/day						
Retaining Wall - HP Pile inserted in Drilled 24-in Dia Sockets, 20’ Socket Depth - 2 piles/day						
Dock, 36-in Dia. Pile Installation, 20’ Socket Depth - 1 pile/day and Wave Attenuator, 24-in Dia. Pile Installation, 20’ Socket - 1 pile/day	2,050	75	2,400	1,080		

Dock 36-in Dia. Pile Installation 30’ Socket Depth and 24-in Dia Pile Installation 20’ Socket Depth	2,900	105	3,500	1,545		
36-in Dock 20’ socket x 2 Dock Abutment	45	10	65	30		34,146
RHIB Fender Piles 24-in x 2	20		30	10		15,849
24-in template 10’socket x 4						
24-in wave attenuator piles-10’socket x 2	35		50			
24-in wave attenuator piles-20’socket x 2	35		50			

Based on our evaluation of the applicant’s proposed measures, as well as other measures considered by NMFS, NMFS has preliminarily determined that the proposed mitigation measures provide the means effecting the least practicable impact on the affected species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Proposed Monitoring and Reporting

In order to issue an IHA for an activity, section 101(a)(5)(D) of the MMPA states that NMFS must set forth requirements pertaining to the monitoring and reporting of such taking. The MMPA implementing regulations at 50 CFR 216.104 (a)(13) indicate that requests for authorizations must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present in the proposed Project Area. Effective reporting is critical both to compliance as well as ensuring that the most value is obtained from the required monitoring.

Monitoring and reporting requirements prescribed by NMFS should contribute to improved understanding of one or more of the following:

- Occurrence of marine mammal species or stocks in the area in which take is anticipated (*e.g.*, presence, abundance, distribution, density).

- Nature, scope, or context of likely marine mammal exposure to potential stressors/impacts (individual or cumulative, acute or chronic), through better understanding of: (1) action or environment (*e.g.*, source characterization, propagation, ambient noise); (2) affected species (*e.g.*, life history, dive patterns); (3) co-occurrence of marine mammal species with the action; or (4) biological or behavioral context of exposure (*e.g.*, age, calving or feeding areas).
- Individual marine mammal responses (behavioral or physiological) to acoustic stressors (acute, chronic, or cumulative), other stressors, or cumulative impacts from multiple stressors.
- How anticipated responses to stressors impact either: (1) long-term fitness and survival of individual marine mammals; or (2) populations, species, or stocks.
- Effects on marine mammal habitat (*e.g.*, marine mammal prey species, acoustic habitat, or other important physical components of marine mammal habitat).
- Mitigation and monitoring effectiveness.

Visual Monitoring

One NMFS-approved, formally trained PSO with prior experience performing the duties of a PSO during construction activities would serve as team leader, supported by three PSOs trained on site or through available online training programs compliant with NMFS standards. PSOs must be independent (*i.e.*, not construction personnel) and have no other assigned tasks during monitoring periods. Prior to initiation of construction, PSOs would complete a training/refresher session on marine mammal monitoring, to be conducted shortly before the anticipated start of the open water season construction activities.

Primary objectives of the training session include:

- Review of the mitigation, monitoring, and reporting requirements provided in the application and IHA, including any modifications specified by NMFS in the authorization;
- Review of marine mammal sighting, identification, and distance estimation methods;
- Review of operation of specialized equipment (bigeye binoculars, GPS); and
- Review of, and classroom practice with, data recording and data entry systems, including procedures for recording data on marine mammal sightings, monitoring operations, environmental conditions, and entry error control.

PSOs must have the following additional qualifications:

- Ability to conduct field observations and collect data according to assigned protocols;
- Experience or training in the field identification of marine mammals, including the identification of behaviors;
- Sufficient training, orientation, or experience with the construction operation to provide for personal safety during observations;
- Writing skills sufficient to prepare a report of observations including but not limited to the number and species of marine mammals observed; dates and times when in-water construction activities were conducted; dates, times, and reason for implementation of mitigation (or why mitigation was not implemented when required); and marine mammal behavior; and
- Ability to communicate orally, by radio or in person, with project personnel to provide real-time information on marine mammals observed in the area as necessary.

Two PSOs must be on duty during all in-water construction activities and must record all observations of marine mammals regardless of distance from the pile being driven or covered activity. PSOs shall document any behavioral reactions in concert with distance from piles being driven or removed. PSOs are limited to monitoring no more than 4 hours per shift with sufficient breaks and no more than 12 hours per day to minimize fatigue.

The placement of PSOs during all pile driving and removal and drilling activities will ensure that the entire shutdown zones are visible during pile installation. Should environmental conditions deteriorate such that marine mammals within the entire shutdown zone will not be visible (*e.g.*, fog, heavy rain), pile driving and removal must be delayed until the PSO is confident marine mammals within the shutdown zone could be detected. The primary monitoring location currently proposed by NSF would be on the roof platform of the Garage Warehouse Recreation (GWR) building (approximately 20 meters above sea level) to provide visual coverage of the Level A shutdown zones. NMFS agrees that the GWR building is an appropriate monitoring location. The primary PSO can monitor the Project Area generally south-southeast while the second PSO can monitor the area generally west-southwest that may be ensonified. With reticle binoculars the distance potentially visible by a 1.8-m tall PSO from this point would be about 4,360 m. Mounted big eye binoculars would be provided to PSOs to better cover the Level A harassment zone. NSF believes this location and is adequate to fully monitor the Level A harassment and shutdown zones, however, we note that sea state, glare, observer expertise, and other factors can affect the ability of PSOs to see and identify marine mammals to hearing group at such large distances, even if those distances are theoretically observable. Local researchers have reported that very little of some level B harassment zones will be visible (Ari Friedlander, personal communication).

Palmer Station normally has 2.8 meter RHIBs, 2 4.8 m RHIBs, and a number of smaller boats that are normally available and used on a daily basis in areas within 2-3 miles of the station (Ari Friedlander, personal communication). NSF has stated that PSOs in boats that would monitor the outer part of the Level A or Level B harassment zones are not practicable because the remote location of the Project Area presents both safety and logistical challenges. Given the comparatively limited information regarding the species in this area and the likely impacts of construction activities on the species in this area, NMFS is specifically requesting public comment on the proposed monitoring and mitigation requirements.

Reporting

A draft marine mammal monitoring report will be submitted to NMFS within 90 days after the completion of pile driving and removal activities, or 60 days prior to a requested date of issuance of any future IHAs for projects at the same location, whichever comes first. The report will include an overall description of work completed, a narrative regarding marine mammal sightings, and associated PSO data sheets. Specifically, the report must include:

- Dates and times (begin and end) of all marine mammal monitoring;
- Construction activities occurring during each daily observation period, including the number and type of piles driven or removed and by what method (*i.e.*, impact or cutting) and the total equipment duration for cutting for each pile or total number of strikes for each pile (impact driving);
- PSO locations during marine mammal monitoring;
- Environmental conditions during monitoring periods (at beginning and end of PSO shift and whenever conditions change significantly), including Beaufort sea state and any other relevant weather conditions including cloud cover, fog, sun glare, and overall visibility to the horizon, and estimated observable distance;
- Upon observation of a marine mammal, the following information: Name of PSO who sighted the animal(s) and PSO location and activity at time of sighting; Time of sighting; Identification of the animal(s) (*e.g.*, genus/species, lowest possible

taxonomic level, or unidentified), PSO confidence in identification, and the composition of the group if there is a mix of species; Distance and bearing of each marine mammal observed relative to the pile being driven for each sighting (if pile driving was occurring at time of sighting); Estimated number of animals (min/max/best estimate); Estimated number of animals by cohort (adults, juveniles, neonates, group composition, etc.); Animal's closest point of approach and estimated time spent within the harassment zone; Description of any marine mammal behavioral observations (*e.g.,* observed behaviors such as feeding or traveling), including an assessment of behavioral responses thought to have resulted from the activity (*e.g.,* no response or changes in behavioral state such as ceasing feeding, changing direction, flushing, or breaching);

- Number of marine mammals detected within the harassment zones, by species; and
- Detailed information about any implementation of any mitigation triggered *(e.g.,* shutdowns and delays), a description of specific actions that ensued, and resulting changes in behavior of the animal(s), if any.

If no comments are received from NMFS within 30 days, the draft final report will constitute the final report. If comments are received, a final report addressing NMFS comments must be submitted within 30 days after receipt of comments.

Reporting Injured or Dead Marine Mammals

In the event that personnel involved in the construction activities discover an injured or dead marine mammal, the IHA-holder must immediately cease the specified activities and report the incident to the Office of Protected Resources (*PR.ITP.MonitoringReports@noaa.gov*), NMFS as soon as feasible. If the death or injury was clearly caused by the specified activity, NSF must immediately cease the specified activities until NMFS is able to review the circumstances of the incident and determine what, if any, additional measures are appropriate to ensure compliance with the terms of the IHA. The IHA-holder must not resume their activities until notified by NMFS. The report must include the following information:

- Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);
- Species identification (if known) or description of the animal(s) involved;
- Condition of the animal(s) (including carcass condition if the animal is dead);
- Observed behaviors of the animal(s), if alive;
- If available, photographs or video footage of the animal(s); and
- General circumstances under which the animal was discovered.

Negligible Impact Analysis and Determination

NMFS has defined negligible impact as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival (50 CFR 216.103). A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (*i.e.*, population-level effects). An estimate of the number of takes alone is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be "taken" through harassment, NMFS considers other factors, such as the likely nature of any responses (*e.g.*, intensity, duration), the context of any responses (*e.g.*, critical reproductive time or location, migration), as well as effects on habitat, and the likely effectiveness of the mitigation. We also assess the number, intensity, and context of estimated takes by evaluating this information relative to population status. Consistent with the 1989 preamble for NMFS's implementing regulations (54 FR 40338; September 29, 1989), the impacts from other past and ongoing anthropogenic activities are incorporated into this analysis via their impacts on the environmental baseline (*e.g.*, as reflected in the regulatory status of the species, population size and growth rate where known, ongoing sources of human-caused mortality, or ambient noise levels).

DTH pile installation, vibratory pile removal, limited impact pile driving for proofing, rock chipping and use of a hydrogrinder have the potential to disturb or displace marine mammals. Specifically, the project activities may result in take, in the form of Level A and Level B harassment from underwater sounds generated from pile driving activities. Potential takes could occur if individuals are present in the ensonified zone when these activities are underway.

The takes from Level A and Level B harassment would be due to potential PTS, TTS and behavioral disturbance. Even absent mitigation, no mortality or serious injury is anticipated given the nature of the activity and construction method. The potential for harassment would be further minimized through the implementation of the planned mitigation measures (see **Proposed Mitigation** section).

Effects on individual animals that are taken by Level B harassment, on the basis of reports in the literature as well as monitoring from other similar activities, will likely be limited to reactions such as increased swimming speeds, increased surfacing time, or decreased foraging (if such activity were occurring) (*e.g.*, Thorson and Reyff 2006; HDR Inc. 2012; Lerma 2014; ABR 2016). Most likely, individuals will simply move away from the sound source and be temporarily displaced from the areas of pile installation, although even this reaction has been observed primarily only in association with impact pile driving. If sound produced by project activities is sufficiently disturbing, animals are likely to simply avoid the area while the activity is occurring. While DTH pile installation associated with the proposed project may produce sound at distances of many kilometers from the project site, we expect that animals annoyed by project sound would simply avoid the area and use more-preferred habitats. Furthermore, during any impact driving, implementation of soft start procedures will be required and monitoring of established shutdown zones will be required for all pile installation and removal activities, significantly reducing the possibility of injury. Use of impact driving will be limited to proofing of piles after they have been set in place. Given sufficient notice through use of soft start (for impact driving), marine mammals are expected to move away from an irritating sound source prior to it becoming potentially injurious. This sort of low-level localized displacement, in the absence of any specific known biologically important areas, would not be expected to impact the reproduction or survival of any individuals.

In addition to the expected effects resulting from authorized Level B harassment, we anticipate that Antarctic minke whales, fin whales, and humpback whales may sustain some limited Level A harassment in the form of auditory injury due to large PTS zones for LF cetaceans. We are also proposing to authorize take by Level A harassment of Antarctic fur seals, crabeater seals, leopard seals, Weddell seals, and Southern elephant seals since the Level A harassment zones are large relative to the ability to detect low profile, species that are common in the region. However, animals that experience PTS would likely be subjected to slight PTS, *i.e.* minor degradation of hearing capabilities within regions of hearing that align most completely with the frequency range of the energy produced by pile driving, *i.e.* the low-frequency region below 2 kHz, not severe hearing impairment or impairment in the regions of greatest hearing sensitivity. If hearing impairment occurs, it is most likely that the affected animal would lose a few decibels in its hearing sensitivity, which in most cases is not likely to meaningfully affect its ability to forage and communicate with conspecifics.

The project is also not expected to have significant adverse effects on affected marine mammals' habitats. The project activities would not modify existing marine mammal habitat for a significant amount of time. The activities may cause some fish to leave the area of disturbance, thus temporarily impacting marine mammals' foraging opportunities in a limited portion of the foraging range; but, because of the relatively small area of the habitat that may be affected, the impacts to marine mammal habitat are not expected to cause significant or long-term negative consequences for marine mammals.

The nature of NSF's proposed construction activities precludes the likelihood of serious injury or mortality, even absent mitigation. For all species and stocks, take would occur within a limited area (Hero Inlet and nearby waters) that constitutes a small portion of the ranges for authorized species. Level A and Level B harassment will be reduced to the level of least practicable adverse impact through use of mitigation measures described herein. Further, the amount of take proposed to be authorized is extremely small when compared to stock abundance of authorized species.

In summary and as described above, the following factors primarily support our preliminary determination that the impacts resulting from this activity are not expected to adversely affect the species or stock through effects on annual rates of recruitment or survival:

- No mortality or serious injury is anticipated or authorized;
- The relatively small number of Level A harassment exposures are anticipated to result only in slight PTS within the lower frequencies associated with pile driving;
- The anticipated incidents of Level B harassment would consist of, at worst, temporary modifications in behavior that would not result in fitness impacts to individuals;
- No adverse effects on affected marine mammals' habitat are anticipated;
- No important habitat areas have been identified within the Project Area;
- For all species, Hero Inlet and nearby waters represent very small and peripheral part of their ranges; and

- The required mitigation measures (*i.e.* shutdown zones) are expected to be effective in reducing the effects of the specified activity.

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the proposed monitoring and mitigation measures, NMFS preliminarily finds that the total marine mammal take from the proposed activity will have a negligible impact on all affected marine mammal species or stocks.

Small Numbers

As noted above, only small numbers of incidental take may be authorized under sections 101(a)(5)(A) and (D) of the MMPA for specified activities other than military readiness activities. The MMPA does not define small numbers and so, in practice, where estimated numbers are available, NMFS compares the number of individuals taken to the most appropriate estimation of abundance of the relevant species or stock in our determination of whether an authorization is limited to small numbers of marine mammals. When the predicted number of individuals to be taken is fewer than one third of the species or stock abundance, the take is considered to be of small numbers. Additionally, other qualitative factors may be considered in the analysis, such as the temporal or spatial scale of the activities.

The amount of take NMFS proposes to authorize is below one third of the estimated stock abundances for all 17 species. For all requested species, the proposed take of individuals is less than 6.4 percent of the abundance of the affected species or stock as shown in Table 20. This is likely a conservative estimate because it assumes all take are of different individual animals, which is likely not the case. Some individuals may return multiple times in a day, but PSOs would count them as separate takes if they cannot be individually identified.

Based on the analysis contained herein of the proposed activity (including the proposed mitigation and monitoring measures) and the anticipated take of marine mammals, NMFS preliminarily finds that small numbers of marine mammals will be taken relative to the population size of the affected species or stocks.

Unmitigable Adverse Impact Analysis and Determination

There are no relevant subsistence uses of the affected marine mammal stocks or species implicated by this action. Therefore, NMFS has determined that the total taking of affected species or stocks would not have an unmitigable adverse impact on the availability of such species or stocks for taking for subsistence purposes.

Endangered Species Act

Section 7(a)(2) of the Endangered Species Act of 1973 (ESA: 16 U.S.C. 1531 *et seq*.) requires that each Federal agency insure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat. To ensure ESA compliance for the issuance of IHAs, NMFS consults internally whenever we propose to authorize take for endangered or threatened species, in this case with the ESA Interagency Cooperation Division.

NMFS is proposing to authorize take of blue whale, fin whale, sei whale, Southern right whale, and sperm whale, which are listed as endangered under the ESA.

The Permit and Conservation Division has requested initiation of Section 7 consultation with the Interagency Cooperation Division for the issuance of this IHA. NMFS will conclude the ESA consultation prior to reaching a determination regarding the proposed issuance of the authorization.

Proposed Authorization

As a result of these preliminary determinations, NMFS proposes to issue an IHA to NSF to conduct the Palmer Station Pier Replacement project at Anvers Island, Antarctica, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated. A draft of the proposed IHA can be found at *https://www.fisheries.noaa.gov/permit/incidental-take-authorizations-under-marine-mammal-protection-act*.

Request for Public Comments

We request comment on our analyses, the proposed authorization, and any other aspect of this notice of proposed IHA for the proposed Palmer Station Pier Replacement project. We also request at this time comment on the potential Renewal of this proposed IHA as described in the paragraph below. Please include with your comments any supporting data or literature citations to help inform decisions on the request for this IHA or a subsequent Renewal IHA.

On a case-by-case basis, NMFS may issue a one-time, one-year Renewal IHA following notice to the public providing an additional 15 days for public comments when (1) up to another year of identical or nearly identical, or nearly identical, activities as described in the **Description of Proposed Activities** section of this notice is planned or (2) the activities as described in the **Description of Proposed Activities** section of this notice would not be completed by the time the IHA expires and a Renewal would allow for completion of the activities beyond that described in the *Dates and Duration* section of this notice, provided all of the following conditions are met:

- A request for renewal is received no later than 60 days prior to the needed Renewal IHA effective date (recognizing that the Renewal IHA expiration date cannot extend beyond one year from expiration of the initial IHA);
- The request for renewal must include the following:

(1) An explanation that the activities to be conducted under the requested Renewal IHA are identical to the activities analyzed under the initial IHA, are a subset of the activities, or include changes so minor (*e.g.*, reduction in pile size) that the changes

do not affect the previous analyses, mitigation and monitoring requirements, or take estimates (with the exception of reducing the type or amount of take); and

(2) A preliminary monitoring report showing the results of the required monitoring to date and an explanation showing that the monitoring results do not indicate impacts of a scale or nature not previously analyzed or authorized; and

Upon review of the request for Renewal, the status of the affected species or stocks, and any other pertinent information, NMFS determines that there are no more than minor changes in the activities, the mitigation and monitoring measures will remain the same and appropriate, and the findings in the initial IHA remain valid.

Dated: August 13, 2021.

Shannon Bettridge,

Acting Director, Office of Protected Resources,

National Marine Fisheries Service.

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